PUBLIC HEALTH REPORTS

In this issue

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service

Mausoleum of Avicenna at Hamadan, Iran

PUBLIC HEALTH REPORTS

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frontispiece

Almost 1,000 years ago, Avicenna (980–1037), the wise physician-philosopher, anticipated today's concern with geriatrics. His great Canon discusses the nutritional, mental, and physical needs of the aging. (Picture courtesy of Iranian Embassy.)

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U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
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Proprieties of Tuberculosis Management

By W. M. PECK, M.D.

THE PATTERN of tuberculosis control changes constantly. It changes in response to new information and needs, altered economy, predominant personalities and fads. Sometimes it flounders in complacency; other times it changes with almost chaotic flurry. But always guiding and determining this pattern are three components, the health department, the private physician, and the sanatorium, each performing a specialized function.

Since tuberculosis, as a contagious disease, is essentially a public health problem, the health department must occupy the position of overall responsibility and initiative. The private physician must guide the attitude of the patient and his community and plead the right of the individual. And the sanatorium, with its clinical and laboratory resources for research, must work out new methods of treatment and new concepts to support a changing and progressive program. Yet it is true that sanatorium physicians, in their more or less monastic seclusion, speak mostly to other sanatorium physicians, and public health physicians may be equally guilty of similar parochial practices. Since we are now in one of the more chaotic periods of change with aspects that are both heartening and hazardous, it is important that these groups maintain the closest possible communication with one another so they may work together wisely and with adaptability through this unusual period of turbulence.

Up to now it has been customary to assert as a dictum that the basic philosophy of treatment has changed little and that drug therapy and surgery are only serviceable adjuncts to an established and time proved system. But now we must recognize that the basic philosophy itself is changing and that this constitutes the most radical departure in the changing pattern of control.

The traditional concept, which is now giving way, was starkly realistic and recognized the uncertainty of predrug therapy and the fact that tuberculosis was essentially a relapsing disease. It aimed at bringing the patient into tentative equilibrium with his disease and at maintaining that precarious balance by sheltered, restricted living. It was harsh treatment. When a patient entered the sanatorium there was forced on him a sudden break in the continuity of his life. Life plans were stripped from him and reconstituted along lines of minor attainment and little responsibility. The usual values were inverted: ambition became evil and laziness a virtue. There was a suggestion of other-worldliness, of Magic Mountain mystery about the treatment, a certain ecstasy which sustained the patient without realism and eventually enervated him. He was taught the doctrine of submission and introduced to the numbing despair of relapse through such slogans as "once tuberculous, always tuberculous." Some patients survived their illness to acquire success or even greatness, but many succumbed

Dr. Peck, presently serving as chest consultant for the North Carolina State Board of Health, Raleigh, was previously medical director and associate superintendent of the North Carolina Sanatorium, McCain. He is the current president of the Southern Trudeau Society.

to the trivial life of semi-invalidism. Thus the "cure" in days when there was no justifiable alternative.

But since then, in a matter of a very few years, a nearly specific group of drugs has appeared, changing the course and behavior of tuberculosis to an extent that it has little in common with the disease we knew only 10 years ago. Such fundamental aspects as its pathology, bacteriology, and perhaps even its epidemiology have been altered by drug action. The significance of these changes we have been slow to recognize and accept because of our innate distrust of the disease and its record for relapse. But now we are beginning to see that with optimal treatment recovery is nearly predictable and that the relapse rate—if we can project short-term results—has dropped almost to the point of removing tuberculosis from the category of a relapsing disease.

This is a difficult adjustment for all of us to make, but obviously we, who deal with tuberculosis, must "catch up" with this new type of disease and exploit its changes for the benefit of the patient and the control program. The period of hospitalization has already been shortened considerably and, as we gather confidence, probably can be shortened more, perhaps very much more. Patients now return to work within a few months of discharge and usually to their previous employment. The need for treatment in tuberculosis, then, no longer should be regarded as an overwhelming personal tragedy, and the period of sanatorium care, though intense and highly specialized, should be regarded merely as an episode which, in itself, does not disrupt or materially alter the continuity of one's life.

These optimistic remarks, of course, cannot apply to all who enter a sanatorium. Belated diagnosis and delayed admission still carry some patients past a point of possible return of adequate function. Some of these still die from tuberculosis; others survive as pulmonary cripples to whom one can offer only prolonged custodial care.

Treatment Regimen

Let us turn now to the treatment which has justified such a reversal of concept.

The goal of drug treatment, ideally, would be to sterilize the lesion of all tubercle bacilli with reversion of the tuberculin reaction. But under usual clinical conditions with our available drugs, this goal cannot be fully realized. Fortunately, there is a tangible alternate goal which falls just short of ideal. This is based on the faculty of drugs, especially of isoniazid, to destroy those bacilli which are in an active phase of multiplication and to depress the metabolic activities of the remaining organisms to a point of inertness, comparable, perhaps, to hibernation—a unique and definite vegetative state. Bacteriologists have shown that many of these bacilli cannot be induced to grow on culture media, whereas others will grow with difficulty only after many months of incubation or with special stimulation. In this dormant state tubercle bacilli continue to produce sufficient tuberculoproteins to maintain a positive tuberculin reaction but not enough to cause progressive disease. Rapid resolution of pneumonic disease and, frequently, cavity closure occur in consequence of this depressed state of the parasite; and we may postulate that host factors—factors which unfortunately permitted disease to develop in the first place—may have opportunity to rectify themselves.

Isoniazid is by far the best drug, and isoniazid and para-aminosalicyclic acid seem to be the most satisfactory combination. Drug therapy is usually initiated by these two, and with almost predictable success. When they fail—as they do rarely under favorable circumstances and frequently under conditions of compromise—one loses much of the sureness, and treatment henceforth becomes difficult, specialized, and less certain. Then one must grope with problems of drug resistance, synergism, and toxicity in seeking successful combinations with streptomycin, cycloserine, pyrazinamide, or viomycin. Sometimes the surgeon must remove refractory areas of disease, the persistent cavity or the caseous mass, before sputum can be converted.

The achievement of the dormant state of the bacilli is the first objective, and the second objective is to maintain them in this state. Fortunately, it appears that dormancy can be maintained by the rather simple expedient of continuing drug therapy. Isoniazid by itself

appears to be adequate for this purpose, and ideal since it is pleasant to take and exceedingly low in toxicity and cost. Probably, continued dormancy can be further assured by the prophylactic removal of those areas prone to reactivation such as residual cavities or areas of unresolved disease which may be relatively inaccessible to the blood stream and hence to drug effect.

The tragedy of drug therapy is the ever-present possibility of interruption or compromise in the early course of treatment. The initial exposure to drugs finds the organisms particularly vulnerable. And intense, supervised drug therapy at this time will cause sputum conversion in about 80 to 90 percent of patients in the first 4 months. On the other hand, if initial therapy is inadequate or interrupted, it may have the deplorable effect of merely altering the host-parasite relationship sufficiently to produce a remarkable degree of chronicity, with active, smoldering disease persisting. It may neither improve nor worsen with further treatment.

Usually, there are about 40 such patients in the 700-bed North Carolina Sanatorium at McCain, N. C., many of whom are in its prison division. For the most part they are poor, defeated creatures with long histories of repeated "short bursts" of drug therapy. Characteristically, their shopworn lesions have practically ceased to respond to drugs, even to new ones, such as cycloserine, yet under flagrant abuse they seldom get worse. Prisoners escape and run for hours or days through the swamps. They go on the bum or work at heavy construction for months before being apprehended and returned, still hale and hearty, but with sputum that is unalterably positive. This kind of disease is the stigma of erratic drug therapy and may be produced in the well-meaning, law-abiding citizen as well as the criminal. There is a heavy responsibility on all of us lest, inadvertently by compromise or misdirection, we encourage another to join this forlorn and hopeless crowd. One must never forget that the period of early treatment is a critical one, and the difference between adequate treatment and almost adequate treatment may be relatively slight.

Assurance of proper treatment during this early crucial period can be given best if the patient is admitted to a sanatorium. Once the organisms presumably become dormant, when the sputum becomes negative and resolution is well under way and any needed surgery is accomplished, the situation alters and much greater latitude is possible. This permits earlier discharge home and earlier return to work under the continued protection of isoniazid for a prolonged period of time, possibly for 1 or 2 years or longer; and this can be done with a degree of safety that is foreign to all earlier experience.

The Home Care Question

This treatment represents the ideal way for handling the tuberculous patient, and one cannot depart far from the ideal without some jeopardy. The question of home care, however, comes up and must be answered. The possibility of treatment at home is appealing to the patient and his relatives and has enough validity even to command critical medical attention. An argument for a home care program might be presented as follows: Drug therapy if carried out conscientiously will cause conversion of the sputum in 80 to 90 percent of initial treatment cases, and it will do this in spite of great latitude in such ancillary matters as bed rest, good nutrition, and psychotherapy. Accordingly, proponents of a program which relies primarily on home care would provide the following:

1. A system of supervision designed to insure uninterrupted drug therapy.

2. Medical supervision which would (*a*) endeavor to admit to the program only those patients who might be expected to have rapid sputum conversion, (*b*) remain alert to the development of complications or possibility of treatment failure, and (*c*) recognize indications for surgery.

These proponents of home care recognize that such a program is not cheap, particularly since the majority of tuberculosis patients require welfare assistance whether in or out of a sanatorium. They recognize that a considerable staff is required, including medical and nursing staff and social workers. Central clinic, roentgenographic, and laboratory facilities must be readily available. Arrangements must be made

for nurses or social workers, or both, to visit the home at monthly intervals. Lansdown and Jones estimated the cost of treating a New York City welfare patient in his home at approximately $6 a day whereas the cost for a similar patient in a local sanatorium was approximately $13 a day. This as well as other estimates would indicate that a home care program is about one-third to one-half as expensive as sanatorium care. Thus, the apparent cheapness of a home care program is largely illusory and is dependent on spreading the cost through a number of departments such as welfare, public health, and social service.

Opponents of a home care program point out that most of the tuberculosis patients come from underprivileged, underendowed groups who cannot assume the responsibility for their care under such a sketchy framework of supervision and that serious lapses of drug therapy will occur. Neither do they believe that bed rest, nutrition, and emotional factors are of so little consequence that they can be left to chance, especially in the determination of long-term results as opposed to short-term sputum conversion rates. They doubt that, without ready access to special facilities, sufficient sputum, gastric, or roentgenographic studies would be made for proper evaluation or that the patient could be readily persuaded to accept surgery at an optimum time. They point out, wisely, that enthusiasm for cheaper care in the home must not blind one to the communicability of tuberculosis or to risk of creating false and disastrous attitudes of nonchalance toward public health aspects of the disease.

The Reasonable Attitude

Until further data are presented a conservative and reasonable attitude in this controversy might be:

1. Where sanatorium facilities exist, reliance should be based primarily on sanatorium treatment, with home care restricted to the convalescent period and to patients temperamentally unsuited to hospitalization.

2. Where sanatorium beds are insufficient and health department personnel and facilities are sufficient to increase activities substantially, a home care program should be developed. This program should be designed with close coordination existing between the sanatorium and home phases of treatment. Under these circumstances most patients would start treatment within the sanatorium for the initial evaluation and indoctrination and for the establishment of a suitable and tolerated drug regimen. After several weeks or months, depending on the demand for beds, the patient might be transferred (not discharged) to the home care program, but he might return to the sanatorium at later dates for periods of reevaluation or for surgical procedures. This is not an ideal program, particularly for patients who must return to forlorn and crowded homes. But it may be justified by circumstances, and it has been reasonably successful as practiced by Lansdown and Jones in New York City, Lichtenstein in Chicago, and others, especially in urban areas where excessive dispersion of the population is not a factor.

The methods of tuberculosis control, then, are by no means immutable since modern drug therapy permits increased flexibility when fundamental principles of administration are respected and accomplished with certainty. The components of a treatment program—the sanatorium, the clinic, the home—may be used with varying emphasis, depending on community resources. Extensive reliance on sanatorium facilities presents the fewest problems and the further one departs from this convention the greater becomes the responsibility, concern, and financial need of the health departments. Programs relying heavily on clinic and home treatment are indeed possible and even justified by circumstances, but they should be undertaken only after sober evaluation of resources and as a major interest. Even so, under carefully controlled conditions, there is justification for further cautious exploration in this direction. There is danger, however, that home care programs may be undertaken somewhat hastily because of a mistaken assumption of great economy, because of popular clamor, or because of insouciance. And there is danger that home care and sanatorium care may be pitted against one another in wasteful competition. Such attitudes must not be tolerated. Instead one must seek constantly to command optimum use of all these community resources.

This concept presents us with opportunity

for building a program on a much broader and more secure base, an opportunity for freshening and strengthening a campaign which has lost much of its momentum, an opportunity for reawakening those forces which once distinguished tuberculosis control measures as an actual crusade in which the entire community eagerly joined.

Federal Water Pollution Control Act of 1956

Federal grants to assist municipalities in the construction of necessary sewage treatment works as a pollution control and water conservation measure, to be administered by the Public Health Service, are authorized in the Federal Water Pollution Control Act of 1956 (P. L. 660, 84th Cong.).

The act also authorizes up to $3 million a year for a 5-year program of grants to States and to interstate water pollution control agencies to assist them in developing their own water pollution control operations. A revised Federal enforcement procedure for control of interstate water pollution and greater Federal support for research are among other important provisions of the act.

Under the revised enforcement procedure, Federal court action to abate interstate water pollution may be taken by the Government at the request either of the State in which the pollution originates or of the State affected by the pollution. Under the 1948 act, the consent of the upstream State was required.

The 1956 act also authorizes an intensified program of research, technical assistance, and training. Research work at the Public Health Service's Robert A. Taft Sanitary Engineering Center at Cincinnati, Ohio, will be augmented by means of research grants, contracts, and fellowships.

The statute authorizes Federal grants of $50 million a year (up to an aggregate of $500 million) for the construction of municipal sewage treatment works.

Construction Grants

The supplemental appropriation for the current fiscal year includes $50 million for construction grants which are to be allotted on the basis of population and per capita income. Under the act, individual grants are limited to 30 percent of the estimated reasonable cost of the project or $250,000, whichever is less. The act requires that at least 50 percent of the grant funds be used to assist in construction of treatment works serving communities of 125,000 or less.

A project must meet six basic requirements to be eligible for a Federal construction grant: (*a*) The project must be approved by the home State's water pollution control agency; (*b*) it must conform to a State water pollution control plan submitted pursuant to the act; (*c*) it must be included in a comprehensive water pollution control program of the Public Health Service; (*d*) the applicant must agree to pay the remaining construction costs; (*e*) the applicant must make provision for insuring proper and efficient operation and maintenance of the project after construction; and (*f*) the home State's water pollution control agency must certify that the project is entitled to priority over other eligible projects on the basis of financial as well as water pollution control needs.

Application Procedures

Preliminary information on the operation of the new act continuing Federal-State cooperation in controlling water pollution has been released by Surgeon General Burney. Placed in charge of the initial operation of the program is Curtiss M. Everts, chief sanitary engineer of the Oregon State Board of Health.

Application forms and related materials will be available to municipal officials and others concerned from State and interstate water pollution control agencies, from the regional offices of the Department of Health, Education, and Welfare, and from the Public Health Service in Washington, D. C.

After completing the form, the applicant will submit it to his State water pollution control agency for approval and request notification on whether the project meets the requirements of the State water pollution control plan.

The Public Health Service will determine which projects satisfy the criteria for propriety of Federal aid and other requirements of the act.

More detailed procedural information will be available with the grant application forms.

Arrangements for the practical application of other provisions of the act are being prepared. The supplemental appropriation also included $2 million for program grants to States and interstate water pollution control agencies and $1 million for administration of the various provisions of the act.

The National Library of Medicine

THE Armed Forces Medical Library has been transferred to the Public Health Service and is now operating as the National Library of Medicine.

Although as early as 1876 the library was called the National Medical Library on the title page of one of its publications, the designation did not become official, and the national character of the library was not legally recognized until 80 years later. On August 3, 1956, President Eisenhower signed the act (Public Law 941) of the 84th Congress establishing the National Library of Medicine "to assist the advancement of medical and related sciences and to aid the dissemination and exchange of scientific and other information important to the progress of medicine and to public health."

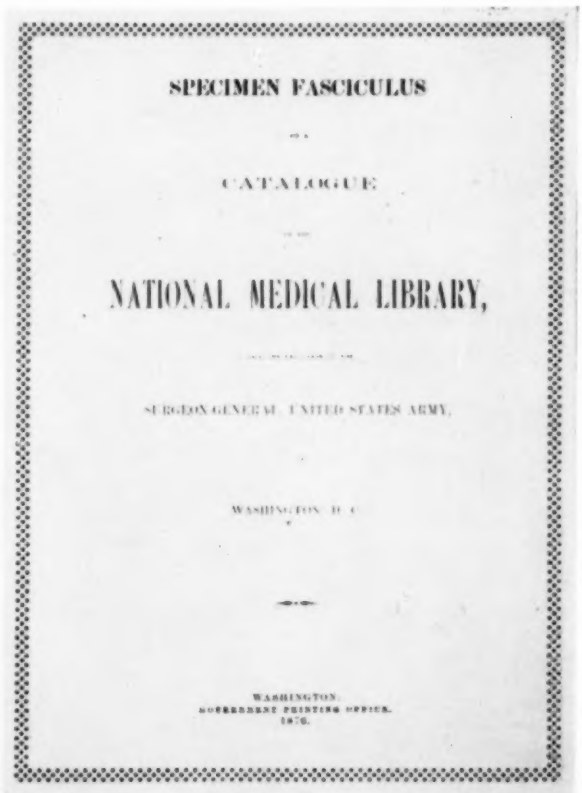
The transfer, observed with ceremony on October 1, 1956, involves the largest collection of medical literature in the Western Hemisphere and one of the largest research libraries in any special subject field. Colonel Frank B. Rogers will continue as director of this institution.

The act places the library under the Surgeon General of the Public Health Service. On matters of policy, scope of collections and services, and the rules under which the facilities of the library are to be made available to users, the Surgeon General will be advised by a 17-member board of regents, 7 of whom will serve ex officio. In addition to the Surgeon General, these are the Surgeons General of the Army, the Navy, and the Air Force, the Chief Medical Director of the Veterans Administration, the Assistant Director for Biological and Medical Sciences of the National Science Foundation, and the Librarian of Congress. The 10 other regents will be appointed by the President from the fields of medicine, library science, or public affairs.

Now entering its 121st year, the National Library of Medicine was founded as the Library of the Surgeon-General's Office (United States Army) in 1836, when Andrew Jackson was finishing his second term as President. It was a time when the heroic therapeutic measures of men such as Bard and Rush were beginning to fall into disrepute. It was the time when Beaumont in the United States and Hodgkins, Addison, and Bright in England were ushering in a new era of medicine.

In those early years the library was little more than a few shelves of books. The manuscript catalog of 1840 listed only 228 volumes. The library grew slowly until after the Civil War. Then two things happened: It received a large sum of money remaining from wartime hospital accounts, and Dr. John Shaw Billings was named librarian. With tireless energy and determination, he began to amass books, reports, transactions, and periodicals from all over the world.

By the end of his 30-year administration, the library's collections had increased from 2,000



SPECIMEN FASCICULUS

OF A

CATALOGUE

OF THE

NATIONAL MEDICAL LIBRARY,

AT THE

SURGEON GENERAL'S OFFICE, UNITED STATES ARMY,

WASHINGTON, D. C.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1870.

volumes to more than 100,000, and the *Index-Catalogue*, which Dr. William Welch, of Johns Hopkins University, once called the most important contribution the United States had made to medicine, had come into being. Dr. Billings had, in fact, accumulated for the library the world's greatest collection of medical literature.

Likewise, but as a private enterprise, the *Index-Medicus* owes its origin to Dr. Billings' vision. Begun in 1880, the index was united in 1927 with the *Quarterly Cumulative Index* to form the *Quarterly Cumulative Index Medicus*. It is now published by the American Medical Association.

After the First World War the library was renamed the Army Medical Library, and again, in 1952, its name was changed to the Armed Forces Medical Library.

Today the library possesses half a million bound volumes and more than a million titles in medicine, public health, dentistry, and allied sciences in all languages and of all times. More than 10,000 serials are acquired yearly by purchase, gift, or exchange, including about 4,500 journals.

Not only does the library have more than 500 incunabula and many thousands of rare books of later dates, but its collection of theses, also started by Dr. Billings, is unsurpassed. The long runs of periodicals give it a character possessed by few other scientific libraries. Its collection of portraits of medical men and pictures of hospitals is growing daily. Its section of American and foreign government and statistical documents is probably unique.

In addition to acquiring medical literature on a worldwide basis, the library organizes its acquisitions by appropriate bibliographical listing, makes them available to users through interlibrary loans and photographic copies, and provides reference and research assistance. From its beginning, in addition to serving military users, the library has been used extensively by the civilian medical profession.

The library publishes the most extensive periodical index in existence today, the *Current List of Medical Literature*. The current list appears monthly, and its subject and author indexes are cumulated semiannually. It has a circulation of 4,500 copies.

A published *Catalog* appears annually and is cumulated quinquennially. It lists by author and subject the books added to the collections.

The *Bibliography of Medical Reviews*, an experiment undertaken in 1955, contains citations for the review literature of medicine which appeared during that year. A second edition is in preparation covering the review literature of 1956.

A series of occasional long bibliographies on topics of current interest has been published since 1950. The most recent example is a study on cancer chemotherapeutic agents, prepared in cooperation with the National Cancer Institute, Public Health Service, now in press as a supplement to *Cancer Research*.

About 15,000 interlibrary loans and about 100,000 photoduplicates are made yearly as an extension of the library's services to other libraries, institutions, and to those users who cannot consult the collections in person. Each month the reference staff answers about 1,000 questions received by mail and over the telephone. The staff numbers more than 200 persons, including several physicians, chemists, and other specialists in the biological sciences. In response to the nature of the literature acquired, the staff embraces an unusually wide range of language competency.

The library has long since outgrown the old red brick building, next to the Smithsonian Institution, into which it moved in 1887. Since 1942, the oldest part of the collection, some 40,000 volumes of its most valuable materials, have been shelved in Cleveland, 400 miles distant from the government agencies which most use the library's facilities. Additional stacks recently built into the old building will provide for the library's needs only for about 2 more years. More than 50 years ago Dr. Billings was saying that "the library is in urgent need of shelving for its additions, some of which are being stored on window sills or on the floor."

In giving a new status and name to the National Library of Medicine, Congress has authorized the construction of a new building on a site to be selected by the Surgeon General at the direction of the Board of Regents. Funds for architect's plans have been appropriated.

review

Selected Papers of Joseph W. Mountin

By E. G. McGavran, M.D., M.P.H.

Selected papers of Joseph W. Mountin, M.D. [Published by] Joseph W. Mountin Memorial Committee. New York, American Public Health Association, 356 pp. Price $5.

• • •

THE PUBLICATION of "Selected Papers of Joseph W. Mountin" by the Memorial Committee is perhaps the finest memorial and tribute possible to a great public health man.

In this historical document, students and scholars of public health can see clearly the phenomenal growth of public health in this century.

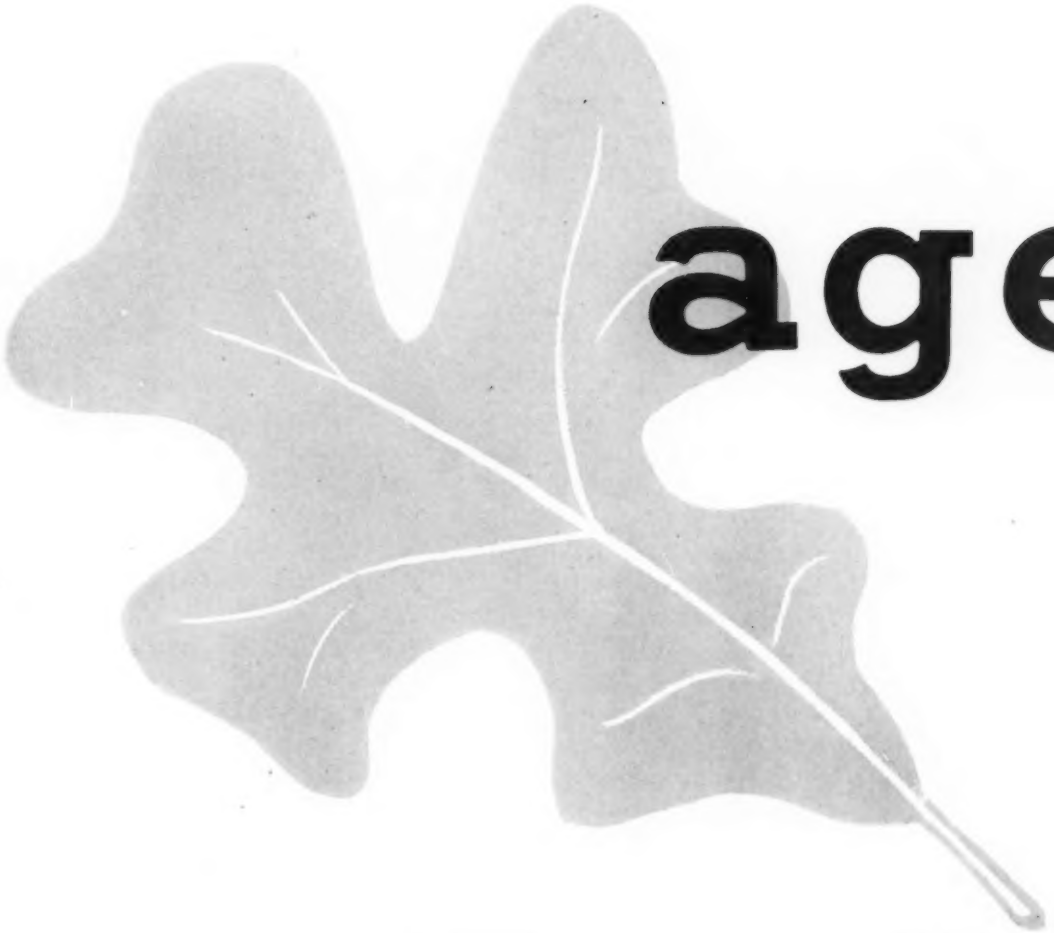
Beautifully planned, organized, and edited, the book holds great value for the careful reader or the skimmer. Each chapter, and frequently each paper, is accompanied by editorial comment and quotations that highlight that particular subject matter. Key words, ideas, and concepts throughout the multiplicity of subject matter stand out and give emphasis through repetition to the character of the author. These are things Joseph Mountin felt to be important in public health. These are the things that made him a public health statesman, ahead of his time but with feet solidly upon the ground.

Each reader may pick for himself the threads that run consistently throughout the fabric of these papers. For example, there is the thread of change: "divine discontent with the traditional, with past or present performance and concepts . . . public health as a dynamic moving force in a changing social order, an emerging science . . . changing concepts . . . changing patterns . . . adaptation to meet the changing needs . . . adjustment to meet new situations."

It is popular today to include gerontology in our list of public health responsibilities, but Dr. Mountin set down forcefully years ago what our responsibility for the aging is and how we may go about meeting this responsibility. He warns us of the dangers of not conforming to the "orthodox" principles in public health—"How free we seem; how fettered fast we are"—but advises that we study scientifically the health needs of our community so that we may promote and conserve its health most efficiently. This is the spirit of scientific inquiry, the spirit of scientific freedom, that challenges the best minds in any profession.

A prominent thread is Dr. Mountin's concern for the future of public health. Glance through the titles of his papers: "Planning for Public Health," "The Evolving Pattern of Tomorrow's Health," "The Future of Public Health Nursing," "Organizing for the Newer Public Health Programs." It is not enough to consolidate our gains, to live on past accomplishments, to hold the line. We must be pushing back the frontiers of knowledge in community health, our distinctive area of competence. The "pioneering spirit" is what is needed, and that spirit requires courage—courage, conviction, and dedication of a high order—for pioneering in health today is more adventurous than was the land pioneering of our forefathers, for we live in the wealthiest and therefore the most conservative nation upon the face of the earth. Dr. Mountin's papers demonstrate this courage as his life demonstrated its dangers. Note the weight he constantly places upon trends, the scientific prognosis of what the future holds for us in health status, health needs, problems, and opportunities.

Another thread is evaluation. Dr. Mountin does not discard programs and activities because they are traditional, but he does emphasize evaluation—constant critical analysis of any program, old or new, to determine its effectiveness, and exploration and research in administrative methods to see if there is a better way to meet community needs. He is not satisfied with scientific diagnosis, prognosis, prescription, or treatment of community health problems. He wants constant scientific supervision and followup. This is the spirit of a great public health physician whose concern is for his patient, the community, and not merely the science of his profession of public health.



The following pages carry material selected for its relation to a single theme: the responsibility of the health professions for the aged population, identifiable less by their years than by their needs. Comments on public health programs for the aging are offered in the leading statement by Surgeon General Leroy E. Burney.

Trends in gerontology and several of its aspects are covered in five papers from the research seminar held at the University of Michigan Conference on Aging at Ann Arbor, July 1956. Reports of other sessions at that conference follow.

Certain recommendations of the first Federal-State Conference on Aging, held in Washington, D. C., in June 1956, are published for their particular value to public health agencies.

Included in the section are two privately contributed reports. Dr. Pemberton and Dr. Macleod assay the health status of a group of men over 40 in a rural area, and Mrs. Belloc reports on eyesight in the aged.

Programs for the Aged

By LEROY E. BURNEY, M.D.

The Surgeon General's address at the banquet for the State and Territorial Health Officers, November 8, 1956, Washington, D. C., was climaxed by the following strong appeal for programs for the aged.

• • •

IT IS IMPORTANT that the public health profession develop swiftly some mutually acceptable principles upon which to base our planning in the vital and inseparable fields of aging and chronic illness.

If we do not institute constructive action to improve the health of the aged and reduce the burden of chronic illness in more communities and States, we will have failed in our plain duty to the people we serve—and that is the whole community not merely a certain segment.

I speak bluntly for the good reason that, at national and State levels, the problem of aging has become a matter of public policy with a high priority for action. It has grown over the years until now it has come to a head, presenting all the classic signs: rubor, calor, dolor, and tumor. Unfortunately, the signs of heat and irritation are observed chiefly in public and private deliberations on how to solve the problems of aging while the aged individual and his family continue to suffer the pain and our national economy, the swelling. Our communities, States, and Nation want some practical, feasible means of treatment.

As physicians and health specialists we can expect to be called in consultation. Are we prepared to give sound advice on what should be the next steps for improvement in our own field, health of the aged?

Health is a central factor in every aspect of the older person's life. It cuts across every social, occupational, and economic line. It affects every proposal for improving the lot of older people in family life, employment, recreation, and participation in community affairs.

A few specialized programs have been initiated in the past decade which, it is true, are directly related to the health of people in the fifth and succeeding decades of life. I refer to community mental health services and tuberculosis, cardiovascular disease, and cancer control. The earlier venereal disease control program also is directly related to adult health. Even if these specialized Federal-State programs were at this moment operating at peak effectiveness in all parts of the country, they could reach only a fraction of the disabilities seriously affecting the adult population of middle and later ages.

And I should be less than candid if I did not say, here and now, that our existing specialized programs reach pitifully few of the men and women who need them most: the aged. As a candidate for that category, I have a personal sense of misgiving when I realize that the age groups which have the shortest remaining life expectancy also receive the short end in health and related services. Yet, there is so much health departments could do now if they had the resources and the vision. We simply haven't begun to apply the knowledge already available.

In terms of national health and national economy, there are incalculable savings to be made through restoration of bed-bound, institution-bound older people at least to self-care

in their homes. It has been done, here and there, by the Allegheny County Institutional District in Pennsylvania, at the Goldwater Memorial Hospital in New York City, and at the District General Hospital in Washington, D. C.

The health maintenance clinic is no longer a pipe dream. This idea for the improvement of adult health is being applied in the University of Miami Medical School and, limited to recipients of old age assistance, by the Santa Cruz County Health Department in California. In New York City and Worcester, Mass., medical societies, health departments, and voluntary agencies are experimenting with "well-oldster conferences." They say the "well oldsters" don't object to the obvious "well baby" comparison, quite the reverse. Equally sporadic is the development of adequate home care programs; yet, 90 percent of the disabled 65-and-over group is at home. Almost untouched is the quality of care in nursing homes; yet, many State health departments are responsible for the licensing of such facilities. So, also, is the idea of cooperative services to the chronically ill and aged in which many community agencies, voluntary and official, participate.

Are we, the appointed guardians of public health, going to remain content with piecemeal services for the increasing millions of older people? We in the Public Health Service are going to give this problem top priority in our program planning. We have already taken some of the steps. We shall take others, assign more personnel, cooperate with the States to the fullest extent of our available resources.

I wish to add one caution. Public health practitioners and private practitioners are not miracle workers. I fervently agree that some of the improvements we could make tomorrow, with relatively simple means, might seem miraculous in their beneficial effects on the lives of many older people. But the social, economic, physical, and emotional problems of growing old in our society are complex and difficult of solution. No efforts on the part of public health and medicine to improve the health of the aged can be fully successful unless society is willing to make parallel efforts in related fields. We cannot be all things to all men. So let our planning for health of the aged be predicated upon the following assumptions:

- That continued efforts will be made to improve financial security of our older citizens.
- That parallel efforts will be made to remove arbitrary restrictions on the employment of individuals because of chronological age.
- That there will be no diminution in the Nation's current medical research effort, leading to more effective health care and control of chronic disease.
- That existing health and rehabilitation programs be sustained and progressively expanded so that maternal and child health services and other preventive and restorative programs may assure oncoming generations a foundation of better health as they reach old age.
- That the concept of Federal-State cooperation and of working together with the professions and the public will continue to inform and inspire all that we do for the better health of the aged.

Trends in Gerontology

By WILLIAM B. KOUNTZ, M.D.

WHAT IS GERONTOLOGY? We might say that it is an understanding of the process of aging, or a form of therapy, or a form of evaluation of the problem of aging. All these are true in their own way, but, actually, gerontology is a cumulative process of thinking in regard to one of the important problems of existence. Gerontology is indeed a broad word, covering many facets of our existence.

Much like medicine itself, gerontology had to create a logical place in the human mind before it could be established. Since thought develops slowly and in stages, the most critical point is usually the one considered first by the mind. Because of the need, generations ago, for attention to the health of the younger individual, the problems of the early years of life were attacked most vigorously and the science of pediatrics was established. It was only after the application of this direction of study and observation of the results that the problems of the period past midlife became critical in the mind of man. We are now at the stage where gerontological control in all its different phases and aspects looms high as one of the greatest needs of mankind.

Since gerontology is divided into different units, or disciplines, we shall consider each one separately.

Dr. Kountz is assistant professor of clinical medicine, Washington University School of Medicine, St. Louis, Mo.

Biology

Since there is definite biological change in everyone from his unicellular state to maturity, the biological problem is important not only in the period of growth and development, but also in maturity and later years. In considering the biological aspect of aging, there are a number of questions that must be asked: Is the body as it ages fixed in its principle so that the changes cannot be modified? Should we expect biological change to be comparable to the process of boiling an egg? Can such anatomical and functional changes as occur with age be modified?

These questions have been answered definitely. It has been shown that there may be a reversal in the picture of tissue, both biologically and functionally, long after the tissue has ceased its normal activity, that actually the functional capacity of the tissue may be returned to near normal and the biological appearance of the cells and tissues may again approach that of younger periods of life. Since this can be demonstrated in certain tissues, it is highly possible that other tissues may be modified in both their functional capacities and anatomical appearance.

It has been shown that the epithelium of the nose and throat may again develop cilia and that an improvement of this tissue may occur after the functional capacity of the mechanism has been greatly reduced. It has been demonstrated that the endometrium of the uterus may be returned to a state resembling its former state in anatomical appearance and even, in part, in function. With proper therapy, the

blood vessels of the uterus may even tend to lose their calcification, which was due to arterial strain. It has been demonstrated that the mental response of a patient may be improved, that such things as memory, ability to coordinate thought, judgment, and the like, may be benefited by therapy. We can say that the biological function and physical tissue may be modified and that they parallel one another. This phase of gerontology needs much research, and much may be accomplished by proper study and evaluation.

Can and should these changes be modified? From my limited experience I feel that knowledge will lead to a definite modification of tissue and its function, which will in turn extend the health of older people. Many of the diseases found in older people are attributed to arteriosclerosis, but since the advent of pathology physicians have found that a clinical diagnosis of arteriosclerosis is not always substantiated by autopsy findings. Children died of diarrhea, which was later found to be preventable by control of the nutritional state of the infant. The trend in biological study is upward, but the ascent is very slow.

Psychology

There are so many factors that influence the psychology of the older person that it is difficult to evaluate them briefly. The need for a better adjustment of the older person to his environment, the need for economic, social, and medical security, all enter into the mental and emotional disturbance of his existence. Control of these factors leads to a healthier outlook on life, to a better understanding of the emotions, and must come through proper education of the individual and a realization on his part that aging is not something to be shunned, but something to be accepted and adjusted to. As most of our youngsters are taught, so should our oldsters be taught that they must prepare themselves for the future in order to have a pleasant corner in life at any age.

There is an increasing realization of the need to develop this thought. I can point particularly to the University of Michigan, which has taken the lead in the control of the psychological aspect of older people. This institution is well known for studies concerning the mental health, the emotional needs, the adjustment to an industrial program, and the education of the older person. Proper thinking in the field of psychology of the aging by the leaders is well assured. Administration of this thought to those who need it is, of course, difficult. It must come with education of the masses of older people. The trend toward proper evaluation in the field of psychology is strong.

Clinical Medicine

Clinical medicine has for generations shied away from the subject of gerontology and is still doing so. Few medical schools teach any of its principles. Few of the teachers in the schools realize its importance, and consequently few teach medical students and interns the problems of aging, particularly the anticipation of disease. They sack up most diseases that occur in older people and call them arteriosclerosis and shake their heads and say: It is inevitable. There is an awakening of thought in the direction that some of the changes that occur with age may be modified and that basic underlying changes which lead to the diseases of the older person may be recognized and treated. However, the problems of geriatric medicine have not yet received proper recognition.

The trend in clinical medicine is a sort of status quo. Many clinicians still think that illness must occur with age. Since they feel that a disease must occur before treatment is started, they are unable to approach the prophylaxis of gerontology. They are unwilling to anticipate that illness may occur unless something is done to direct and control the body functions. It is important to emphasize that acute phases of chronic disease do not occur suddenly; rather they progress slowly and have their existence as a result of changes that began long before the acute phases developed. Internal medicine needs to take a page out of the book of pediatrics from the standpoint of prophylactic and anticipatory medicine.

Nevertheless, the clinical state of the older patient has been much improved. Many types of conditions that frequently lead to chronic diseases are now controllable. For instance,

hypertension, or high blood pressure, has been brought under control to a great extent in the past few years, a fact that will doubtless help to prevent illness in many oldsters. The understanding of dietary problems, such as the influence of fats in the control of arterial disease, and the understanding of the nutrition of the body likewise play an important part in the control of chronic disease. Surgery, with its ability to replace diseased blood vessels, leads to improved health in the older person. The early recognition and surgical treatment of cancer of the breast, the uterus, and the lung also help to extend health into the later years of life. And much could be said about the introduction of medications and techniques in specific disease, all of which lead to better health.

The trend in the clinical aspect of the control of disease in older people is definitely upward, but there is still need for earlier recognition and earlier clinical evaluation before prevention of disease can come into its own. The treatment and control of disease in older people has been much improved, and the trend to better health is a trend to a brighter outlook.

Other Aspects

The social, economic, and religious aspects of life for older persons vary a great deal from these aspects of life for young people. The social aspect is often modified by a change in clinical health, in economic ability, and particularly in the psychological outlook of older individuals. That social needs should be recognized and social adjustment aided there can be no doubt. The trend is in this direction: for example, social security, old age pensions, and housing projects for the aged. Fraternal organizations and other groups are beginning to make moves toward meeting the needs of their retired members. In my experience the social aspect is always conditioned by psychological and clinical health. Those in poor health need social adjustment and social help; those in good health maintain their own level.

Another trend of great importance is the increasing concern among lay people with the results of gerontological research. If properly directed, their interest can speed the progress of gerontology. It will serve to create a demand on scientists and physicians to develop the knowledge necessary to assure health in the later years. This emphasizes the need for the formation of foundations to help develop further study and to establish funds for research, as well as to permit the expression of lay people in the field. This type of organization enables the layman and the scientist to become partners in gerontological research, and no more important a relationship can be established. One such organization, the Gerontological Research Foundation, has already been set up.

Directs Program on Aging

William C. Fitch, of the Bureau of Old-Age and Survivors Insurance, has been named director of the special staff on aging, a newly created post in the Department of Health, Education, and Welfare.

Mr. Fitch, who began his career in 1937 as assistant manager of the Kingston, N. Y., Social Security District Office, was assistant to the director of the Bureau of Old-Age and Survivors Insurance prior to this appointment. He was a member of the Department's Committee on Aging and consultant to two of the annual University of Michigan conferences on aging. In September 1956 he returned to the United States after serving for a year as social insurance adviser to the Government of Israel.

The special staff on aging represents an expansion of the Department's program on aging. Clark Tibbitts will continue as chairman of the Department's Committee on Aging, established in 1950.

Psychological Limitations That Occur With Age

By JAMES E. BIRREN, Ph.D.

THE PURPOSE of this paper is to describe a few limitations that may occur with age and to draw some preliminary inferences about the underlying mechanisms. The scientific literature on the psychological aspects of aging is increasing. The contributions from the Cambridge Laboratory in England (*1–4*) and the publications of numerous investigators in this country have given us many facts to digest. Recently, reviews have appeared on special aspects of aging, such as psychomotor changes, changes in mental abilities, and changes in personality (*5–7*). Many summaries of the literature were presented at the Bethesda Research Conference on the Psychological Aspects of Aging (*8*). With this factual background in mind, it is proper that we begin to consider some of the general mechanisms which may underlie the psychological limitations of aging.

It is implicitly assumed that from considerations of basic facts and information suggestions will become apparent for the prophylaxis and alleviation of many of the limitations which occur with age. Because we use the term "limitations of aging," it should not be assumed that aging is inevitably linked with limitations. The advantages associated with advancing age, like those of growth, take care of themselves, but limitations and defects do not. To these we must direct the knowledge of our sciences and professions if we are to increase the number of healthy, happy, informed, and independent older persons.

Dr. Birren is chief of the Section on Aging, Laboratory of Psychology, National Institute of Mental Health, Public Health Service, Bethesda, Md.

A Point of View

There are two psychologies to be considered in relation to limitations of aging. One is clinical and is concerned with diagnostic, therapeutic, rehabilitative, and supportive procedures. The other is directly concerned with research or experimentation on mechanisms of aging. The point of view adopted in this paper is that of research. We are seeking explanatory principles that might begin to link the now disparate facts about aging.

Generalization vs. Individual Differences

For many psychological and biological processes, about 50 percent of the variation in the data is explained by the general age trend. Thus, in many studies, the range of individual differences is about equal to the magnitude of the mean trend. Whether we emphasize the general trend in our psychological or biological data or the range of individual differences depends upon our purposes. The clinician is more often interested in the uniqueness of the individual under study than in the general characteristics he shares with other people. The biologically minded psychologist is more often concerned with an analysis of the general

characteristics. Both the general trend and the range of individual differences are proper subjects for study.

An Emerging View

As individuals, we are continually concerned with an emerging point of view toward human aging, that is, the proper combination of generalizations with specific facts from personal experience. At some point the experimenter joins with the clinician and with informed people in general to give an appropriate weighting or perspective to the facts of psychological limitations in aging. But what facts should be emphasized? Should we emphasize that there appears to be a disparity between the observable anatomical changes of aging of the nervous system and the changes seen in individual behavior and personality? If this is emphasized, we encourage acceptance of or complacency about our lack of knowledge concerning the relations between psychological functions and the structures of the nervous system. It does not appear to be sound mental health to encourage the idea that successful aging is entirely a voluntary phenomenon and that all older people are capable of doing outstanding things if they would only try. The mature point of view toward human aging seems to represent a balance between optimism and realism and an avoidance both of excess voluntarism and of undue stress on the limitations of aging.

Speed in Timing in Human Behavior

Perhaps the most significant result of research on age changes in the nervous system in the past 10 years is the implication that there is a general slowing of all voluntary responses. In a previous review it was pointed out not only that the slowing of voluntary responses with age is an overt manifestation but also that there is evidence of slowing of covert responses in aging, such as speed of associations of thought (*9*). The change in response latency appears to be our most fruitful point of departure for exploring the nature of age changes in behavior and perhaps for the significance of the age changes in the structures of the nervous system.

In young adults individual differences in speed seem to have only limited psychological importance. In aging, however, individual differences in speed or response latencies seem to be an important independent variable for the psychologist to consider. Recent research suggests that the time delay between stimulation and response is primarily a property of the central nervous system, whereas earlier research tended to minimize the importance of time differences that might be observed in simple and choice reaction time measurements. The slowing with age has to some extent been viewed as an arbitrary or artifactual aspect of performance of the older person. Implicit in such a view is the assumption that the slowing occurs only in the response or output mechanisms and is unrelated to the speed or the quality of events preceding the initiation of response. Were the loss of speed with age a peripheral phenomenon, it would of course be of limited psychological interest.

Simple speed tests seem to differentiate more clearly between senile psychotic individuals and control subjects than do various combinations of rather complex mental tasks. For example, a 2-minute writing test was found to differentiate senile patients and control subjects (*10*). In contrast, a 1½-hour psychometric test designed to measure deterioration did not yield such differentiation. Again, later studies showed that this difference was not simply a peripheral limitation on the writing speed, but that the speed of writing was correlated with the probability of the antecedent events being correct (*11*).

What requires the additional time in the older nervous system? Does a timelag occur in the retina or in the optic nerve? Is there an increased latency in the primary sensory projection area of the brain or in an association area? Is additional time required in programing appropriate motor responses in the motor cortex or in the spinal cord? Does the peripheral nerve or the myoneural junction require more time in its functions?

It was originally thought that older people adopted a slow tempo of response. Hence the increased latencies of voluntary responses were not viewed as a reflection of reduced capacities of the nervous system but phenomena of attitude or set. It has now been shown that at

least in one other species, the rat, a slowing of response latency occurs with age. In a recently published study of startle responses of rats of different ages, it was shown that for older rats there is an increase in response time to electric shock and to sudden noises (*12*). Furthermore, when attempts were made to decrease the response time of these animals by increasing the electric shock, a minimum reaction time was reached beyond which a further increase in the stimulus strength did not result in a further reduction in reaction time. At this plateau, or asymptotic level, of response, there was a residual difference between young and old animals.

An experimental attempt was also made to see to what extent the slowing with age could be related to conduction velocity of peripheral nerve in the rat. In this study the conduction velocity was measured in isolated sciatic nerve excised from more than 75 rats ranging in age from 50 to 850 days (*13*). Conduction velocity increased during development, but it did not change significantly after about 300 days. The results of that study taken together with results of previously reported studies indicate that changes in peripheral nerve do not appear to be important in the changes which we see in such functions as simple reaction time in later life (*9*, *14*).

Recent and unpublished studies by Dr. Alfred Weiss of the National Institute of Mental Health and by Dr. Botwinick, also with the institute, and myself have found no evidence as yet that the age changes in the speed of human voluntary response to any large extent lie in either the receptor or in the effector processes. An earlier study by Johannes Sommer indicates that the age change in a simple spinal reflex in the human is small; it seems to be of the order of perhaps 1 millisecond compared with the 50 or more milliseconds that differentiate the voluntary responses of a young and an older person (*9*).

The recent work of Kumnick on pupillary responses to light indicates that under some circumstances the latency is unchanged with age. This implies that at least under some conditions the rapidity of all the events, from the stimulation of the receptors in the eye to the effecting of pupillary constriction, must be unchanged with age. Apparently, the older pupil constricts at a normal rate in proportion to its smaller size. Since the older pupil is usually somewhat smaller, it may, however, give the illusion of a slower response. If this rather complicated reflex remains unchanged in later life, we might speculate that some of the purely sensory components are also unchanged in relation to latency of perception and the initiation of voluntary responses.

Apparently, the decrease in speed of voluntary responses with age is primarily a phenomenon of the central nervous system and conscious behavior. This provokes a dilemma because the physiological methods which might be appropriate to a study of the phenomenon are ones which are so artificial (for example, anesthetizing the organism) that they preclude studying manifestations in the conscious state. The problems lie in an experimental area wherein the relevant types of experimentation and variables are familiar to the experimental psychologist, and the inferences lie in the domain of the neurophysiologist.

A depressed person might respond slowly and yet retain a capacity to respond quickly, whereas it is extremely doubtful that the older organism maintains the capacity for rapid response. Responses of the elderly are made at some uniformly slow rate (*15*). This suggests that we might speak of less "temporal modulation" of voluntary responses. Implications of this concept are important in attempts to define the environment wherein the older person would be most comfortable. In general, the older person is most comfortable in a situation in which he can pace his responses and is least comfortable in one in which he must respond quickly to demanding sequential stimuli. Rapid sequential stimuli occur, for example, in automobile driving. This situation is not revealed satisfactorily by an analogy to a simple reaction-time experiment. Recent findings in our laboratory show that there is a difference in readiness to respond in the elderly as compared with the young. Different age curves were obtained for changes in response time as a function of preparation. It is not possible to say at this time whether the lower level of response readiness or expectancy is independent of the increased latency or is a different mani-

festation of a common underlying change in the character of nervous system functioning. Also, we do not yet know whether complex tasks merely show a multiplicative effect of the longer latencies. Again it may be that the same basic process is simply disproportionately represented in a complex situation.

Serial Movements in Timing

There is evidence that one of the limitations older persons face is difficulty in timing sequential events. Kay pointed out that his learning experiments suggest that with advanced age some individuals display a difficulty in "programing" sequential movements (*1*). This was noted also in earlier work on age changes in handwriting. In some aged individuals handwriting tends to become a series of discrete movements, instead of a smooth, overlapping of movements, that is, it becomes more like drawing. This is analogous perhaps to a change in a feedback mechanism wherein the older organism is unable to use the information obtained from the execution of a preceding movement to modify a following one or is unable to do so with sufficient speed. Singleton pointed out that the speed of movements, once the movements are initiated, is unchanged in older persons. What requires additional time with age is the decision points in movements (*2*).

For optimum skill, the proper moment for initiating responses must be anticipated. Components of serial responses must be programed in advance to conserve time. If the response components are not anticipated or programed they appear as discrete events separated by delay intervals. A slowness in developing or programing future responses may limit the aged in the execution of some highly complicated skills, the essence of which is the flowing of activities or movements one into the other. It is perhaps highly relevant to note that, when a skill is first acquired, the component movements appear discrete and that, as the skill is improved, these movements are gradually combined into a continuous pattern. As a skill deteriorates, it may again assume the quality of separate movements. Timing seems to have a perceptual character, that is, one sees or feels the right moment to make a response. Difficult conditions exist when the signals come close together.

In the preceding remarks, the facilitation of voluntary response was emphasized. However, in the aging nervous system there may exist a general change in excitability which would be reflected in both facilitatory and inhibitory functions of the nervous system. Perhaps more common in daily life than a demand response to a stimulus is the situation in which the stimulus may be anticipated and received in advance of the appropriate moment for the response. Good timing may thus be more a matter of inhibiting the response until the proper moment than a matter of its facilitation. In aging there may exist a narrowing of the range between minimum response time and maximum response time. This topic requires more information than now exists about the length of delays which can be interpolated between sequential stimuli without the behaviors disintegrating or being forgotten.

Viewed from one aspect, the nervous system appears to be more determinate in the aged than in younger persons, that is, the output tends to be more directly a function of the input. There is, of course, a tendency to cultivate certain types of determinacy or redundancy, as in the social graces. It is of interest to note that the social facade may be the last bit of behavior to disintegrate in the senile individual. Our psychological data on aging should be sifted for influences of our cultural pattern that determine which areas of our behavior may be novel and which are expected to be predictable.

Perceptual Difficulty

Perceptual difficulty, or inability to perceive information in order to achieve an appropriate response, may contribute to the age changes in behavior. One experiment attempted to see to what extent the response time of old and young people would vary as a function of perceptual difficulty (*16*). Young and elderly subjects were required to judge which of two simultaneously presented lines was the shorter. The lines were presented tachistoscopically. Each subject made a minimum of 48 judgments in a series of line pairs which differed in length from 1 to 50 percent. The subject was required

to respond as quickly as he could when the lines were presented by saying "right" or "left" to indicate the side of the shorter line. The vocal response of the subject interrupted a chromoscope circuit, and his response time was measured to the nearest one-hundredth of a second. A significant difference in response time between the two age groups was found at all levels of difficulty of judgment. The response time of the elderly was relatively longer, however, when the stimulus difficulty was increased. Thus, the difference in response time between the young and the elderly subjects was 0.47 seconds at a 1 percent difference in line length, whereas for a 50 percent difference in line length the response time of the young and older subjects differed by 0.18 seconds. It is apparent that perceptual difficulty can contribute to the slower response of elderly subjects. However, there is a residual age difference in response time which exists regardless of the ease of the perceptual task involved.

Again, one might question whether a large part of this difference in response latency is not due simply to the difference in speed of vocalization. For this reason we conducted another experiment in which we studied age differences in finger, jaw, and foot reaction time to auditory stimuli (*14*). The hypothesis was that, if a general factor were underlying the age change in response latency, we would get a constant increment in reaction time with the jaw, finger, and foot. If the age changes were primarily involved in the peripheral pathways, then the reaction time with the foot with its long pathways might be disproportionately slow as compared with the finger or jaw. In this study, the reaction time of the elderly subjects was significantly slower than that of the young subjects for the finger, jaw, and foot, but there was no relation to the length of the peripheral path involved. Since the age differences between the reaction-time means did not change significantly in comparing the finger, foot, and jaw, it may be concluded that the age change in reaction time is not a variable associated with the length of the peripheral path. Collectively, the evidence suggests that it is plausible to regard the age change in response latency as a general property of the central nervous system.

Summary

For many psychological and biological processes there is a general age trend which in some instances explains about 50 percent of the variation in the data. There is an equally large range of individual differences. It depends upon our purposes whether we study and emphasize the general age trend or the individual differences in aging. Both the general age trend and individual differences are important.

Perhaps the most significant result of research on age changes in the nervous system is the implication that there is a generalized slowing of all voluntary responses. On the whole, the evidence indicates there are grounds for regarding the age change in response latency as a general property of the central nervous system. The longer response latencies appear to have their greatest consequence for complex or serial activities. The facts offer suggestions for further research into the bases of the changes, as well as for structuring the environment in order to reduce problems of living due to the psychological limitations of aging.

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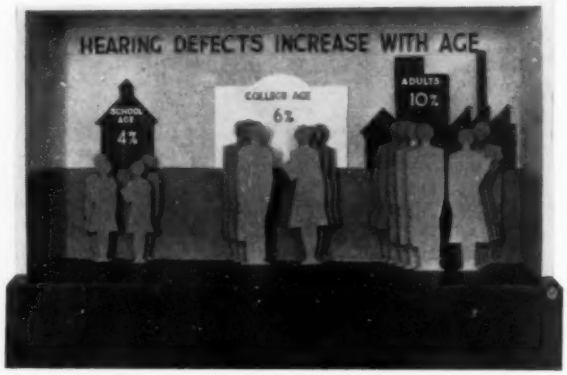

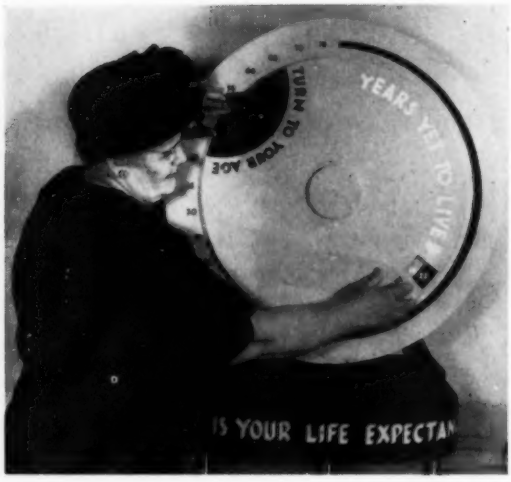

Making Health Visible

Among the exhibits and other educational materials offered by the Cleveland Health Museum in its catalog, "How to Make Health Visible," three illustrated on this page are among those which particularly concern the subject of age. One is a device which permits visitors to learn the average life expectancy, according to present mortality tables, for their age and sex. Another illustrates the point that aging begins with mitosis. The third illustrates the gain in hearing deficiencies with advancing years.

Changes in Nervous System With Age

By HARRY H. WILCOX, Ph.D.

THE NERVOUS SYSTEM is unique and its basic cellular structure is very highly specialized and diversified. The individual nerve cells in one small circumscribed area or nucleus may be markedly different in structure, action, and reaction from those neurons that form an adjacent group. These neurons, even with their many unsolved problems, are far better known anatomically and physiologically than the greater bulk of the nervous system, their supportive structures. These structures, including the glia and the ground substance, are within the bounds of the existing frontiers of neuroanatomy and neurophysiology. So much of the normal picture of the nervous system is so scantily known that departures from the normal are at best determined with difficulty.

A host of neuroanatomical alterations in the nervous system accompanying the process of aging have been described. Many of these so-called manifestations of aging occur in the very young as well as in the old. Some of these, when they occur in the young are undoubtedly abnormal, whereas the frequency with which they occur in the old might cause them to be labeled as normal alterations accompanying aging. Aging should be looked upon primarily as a physiological stage and not a pathological condition. The normal alterations that bring about or occur with the gradual and continual advance from one plateau of life to another are apt to be quite subtle. They therefore are difficult to determine or locate accurately, and difficult to separate from abnormal changes brought about by modifications in internal or external environmental conditions as influenced by disease or trauma. The separation of these changes from artifacts or post-mortem changes, often uncontrollable in human material, cannot be overemphasized.

Dr. Wilcox is associate professor of anatomy, University of Tennessee Medical Units, Memphis.

In human peripheral nerves it has been shown that there is an increase in connective tissue and a reduction in the patency of the blood vessels (*1*, *2*). This begins in the fourth decade of life as an endothelial proliferation and hyalinization of the vessels with an increase in the endoperineurium invading and apparently replacing areas of the nerve bundles by connective tissue elements. With this gradual reduction in blood supply and increase in connective tissue, there seems to be a gradual alteration and reduction of the nerve fibers, especially the larger ones. These findings parallel the measurements of the conduction velocity in human nerves (*3*) which indicate that, beginning in the fifth decade of life, there is a slight but continual decrease in conduction velocity. Again the responsibility may be placed on a decreased vascular supply due to a local ischemia and changes in permeability of the vessels accompanying metabolic depression.

The conduction velocity of peripheral nerves in the rat (*4*) markedly increases during development, with a leveling off at maturity. In contrast to findings of the human studies, little change in conduction velocity was noted in rats after maturity was reached.

Counts of fibers in the dorsal and ventral roots of the eighth and ninth thoracic levels, as

well as cell counts of those dorsal root ganglia, taken from human cadaveric material (*5*, *6*), indicate a marked decrease in both number of myelinated fibers and cells after the fifth decade of life. However, in view of the rather wide range of variation within the relatively small groups of similar ages in these studies and the degree of overlap between groups, additional studies of this type are needed to substantiate the existing evidence.

Certainly, if in the normal course of aging, the metabolic activities of peripheral nerves are so disturbed as to produce a marked numerical decrease in the components, the effect on the normal course of the processes of degeneration and regeneration might be quite marked. One study of the effect of age on wallerian degeneration in the rat was carried out on fairly young animals (*7*). In this study it was demonstrated that in young animals there was a more rapid cellular proliferation and a less rapid loss of myelin than in older animals (160 days of age). Another report (*8*) demonstrates that in older animals more general and extensive signs of retrograde degeneration were present than in young animals, with a striking increase in the number of macrophages present in the sectioned dorsal roots of the older animals, but with a slower rate of removal of debris. This might be due to a lower metabolic rate, although it is not entirely in keeping with the findings of a comparable nerve fiber regrowth rate as evidenced by similar numbers of regenerating axons distal to the anastomosis. In the older animals, there was a diminution in the number of fibers successfully crossing the scar and in the rate of growth beyond. The proliferation of capillaries in the anastomosed roots of the senile rats was quite impressive.

Ganglial Degeneration

Cells of the dorsal root ganglia and the gasserian ganglion in the human, as well as in cats and rats (*9*, *10*), undergo a fatty degeneration which consists of a clumping of the Nissl substance, a subsequent destruction of the neurofibrillar reticulum, and a coalescence of the vacuoles. The cell becomes quite foamy and swollen and finally is destroyed, leaving behind only cellular debris. Although cell counts made on this material indicated no marked difference between young and old individuals, the numbers were relatively small, and statistical measures could not be applied to test the data. Atypical cells, such as the frayed cells of Cajal, fenestrated cells, cells with end bulbs, and so on, seemed to occur commonly in these ganglia at all ages.

Degenerate changes in occasional cells with a moderate degree of neuronophagia have been reported in human autonomic ganglia, with an increase of the interstitial tissue of the ganglia (*11*), as well as variations in the chromidial substance, shrinkage, hyalin degeneration, hydropic alterations, pigmentation, nuclear displacement, vacuolization, and partial or complete destruction of the cell (*12*). While in dogs, many of these variations seem to be related to aging, there was some question about the correlation in man. Even pigmentation was questionable since in man apparently many factors contribute to deposition of pigment.

A subsequent study of this pigment (*13*) found it to be a lipofuscin type closely related to ceroids and not to melanin. It seems to be one of three materials present in the nerve cells that are periodic-acid Schiff positive. The other two are glycogen, which is found in dogs of all ages, and a mucoprotein. Lipofuscin was not found in dogs less than 10 years of age, while in man it was present in varying amounts at all ages from 7 to 92 years. The mucoprotein is limited to nerve cells of the peripheral nervous system and is present to a greater degree in the autonomic cells. It is present in all nerve cells in a granular form in both senile and young dogs but is not concentrated enough in the young animals to be demonstrated by the periodic-acid Schiff method (*14*). Lipofuscin has a much wider distribution and seems to be more concentrated in the efferent nerve cells.

The pigment of the autonomic ganglion cell has been considered (*15*) to be, or to contain, a hormone or a similar substance which represents part of the neurosecretion of the nervous system. The origin of the pigment from the Golgi apparatus has been suggested.

The variability of the Nissl pattern and of the number of cells in the chain ganglia of similar size has been shown in the rat (*16*) and in the guinea pig (*17*). The series of animals used

in these studies did not, unfortunately, include senile forms, but the series from fetal to mature stages form bases for further investigation.

No data on the effect of age on the regenerative capacity of the fibers of the autonomic nervous system exists. It would be most interesting to follow this process in senile forms.

Central Nervous System Changes

Changes similar to those described in the ganglion cells are reported in the various areas of the central nervous system. In the spinal cord (*18*), the general histological structure begins to alter after 30 years of age, and by 60 years the changes are quite marked. Vascular alterations, gliosis, and demyelination, especially in the fasciculus gracilis, pigmentation of cells, and formation of corpora amylacea were among the findings. Pyknosis and chromatolysis in the cells of the ventral horn did not occur frequently and certainly were in no instance pronounced enough to be significant.

Pigmentation was such a constant finding in individuals in the fifth decade of life and older that it was felt that if pigment atrophy is considered an abnormality one could scarcely find a normal spinal cord after the age of 40 and, by the seventh and eighth decades, hardly a normal ganglion cell could be found. In some cells the change was so severe that the cell appeared as a pyknotic pigment spot. Corpora amylacea were not reported in spinal cords of persons less than 30 years of age; after the fourth decade it was a frequent occurrence, especially around the entrance of the dorsal roots.

Changes in the Brain

Several studies indicate that the gross weight of the brain decreases with age. One of these (*19*), a study on 2,060 brains of white males whose ages ranged from 12 to 96 years, reported that there was a gradual increase in the weight of the brain up to 30–34 years of age, and then a gradual, uniform decrease takes place. The maximum decrease occurring between the 3d and 10th decades of life was approximately 11 percent. Accurate determination of the weight of the brain is quite difficult. It has been pointed out (*20*) that simple severance of the brain, the treatment of the meninges, and the removal of the cerebrospinal fluid are rather variable factors (*20*). These sources of error can be minimized if one individual removes and handles the brains; otherwise, those variables must be considered in analyzing samples.

The brain size has been said to fluctuate inversely with economic level (*21*). Since most of the brains obtained in routine autopsy in hospitals come from persons of the lower social strata, they may not be too representative of a cross section of the total population.

The reported decrease in brain weight does not seem to be due entirely to a difference in water content. There are studies that report a definite decrease in water content in the brain throughout the entire life span (*22*, *23*). This decrease varies somewhat with different species since there seems to be a remarkable correlation between physical and mental development at the time of birth and subsequent water loss. One report on senile human brains differs from the others in that it states that there is an increase in the water content in senile brains (*24*). There seems, however, to be universal agreement on the higher water content of the cortex and the lower water content of the medulla, which has suggested that the phyletically newer parts of the brain are wetter.

Phyletically different brain areas also seem to show differences in the cholinesterase activity (*25*). In rabbits, the medulla reached its maximum activity at 15 days and then fell 50 percent by 2½ months of age. The activity remained fairly stable after that time. In the frontal cortex and caudate nucleus, the maximum activity was reached at 18 months and then held steady. However, no general conclusions as to the correlation of the cholinesterase activity have as yet been made with senility.

Young and adult rats differ in that the adult brain contains more fat and phosphorus. In extreme age there are small decreases in fat, acid soluble phosphorus, and potassium, with an increase in sodium (*23*).

The cerebral physiology of the human has been studied by the nitrous oxide method to show that there is a close correlation between advancing age and decreasing blood flow with a concomitant decrease in oxygen consumption (*26*, *27*). This decrease in oxygen availability

and consumption may be closely related to neuronal activity. There seems to be almost universal agreement that, with increase in age, there is a marked decrease in the number of neuronal elements in the brain. However, most of the observations and cell counts upon which this conclusion is based have been made on relatively small series of human brains, even on a single specimen and with known mental deterioration frequently clouding the issue. Counts on large series of experimental animals are likewise scarce.

A recent report shows a decrease in the number of cortical neurons with increasing age, especially in the superior temporal gyrus and the lower quarter of the precentral gyrus (*28*). Unfortunately, this study is based on a very small sampling of a remarkably variable population. Variability is immediately apparent when one examines the raw data presented by the various investigators.

Only by the use of large samples, which in studies of this kind are most difficult to procure and study, can this source of error be overcome. It is indeed reasonable to believe that, in a cell which has lost its ability to reproduce and which functions more or less constantly over the years, physiological and anatomical deterioration can readily occur either as a perfectly normal process or as a consequence of some external or internal environmental disturbance. Therefore, not only is the mass of evidence—even though still circumstantial and not entirely conclusive—in favor of the decrease in cell numbers with age, but it seems logical to expect it. I merely point out here that there is still a great need for quantitative studies on the brains of humans and experimental animals, quantitative studies that consider variables and try to control them. Proof for one species cannot necessarily be had from studies on another, since it appears more and more that there is a marked difference in the aging of the nervous system in different species.

Purkinje Cells

The population of the Purkinje cells is reported to suffer severely with advancing age. In a description of the Purkinje cells of a 92-year-old man, it was stated the cells "appear considerably shrunken, both nucleus and protoplasm, though not more so than normal daily fatigue" (*29*). This individual was in a coma and endured 6 days of inanition prior to death. The Purkinje cells were reported to be 25 percent fewer than in the cerebellum of a 47-year-old man. In another study of the cerebellums from 63 humans of both sexes, aged 12–92 years, 43 cerebellums were eliminated from consideration because they "showed the greatest losses," and "cell losses are frequently due to disease" (*30*).

Similar decreases in Purkinje cells in the dog, the macaque (*31*), and the rat (*32*) are reported. Reducing the rat to the equivalent age of man, it was concluded that destruction of the cells or the processes leading to destruction take place 30 times as fast in the rat as in man.

A loss as high as 40 percent in the Purkinje cells of guinea pigs has been reported (*33*). However, this figure is based on the number of cells in the newborn as 100 percent, and it is important to note that the highest percentage loss—66.7 percent—occurred in one animal of 193 days of age (*34*). In one area of the cerebellum, 7 animals out of the 10 younger than the oldest (1,800 days) of this series showed more loss of Purkinje cells than did the oldest animal.

In my own series of guinea pigs, whose ages range from 139 to 2,765 days, I have been unable to measure quantitatively any loss of the Purkinje cells. On the contrary, the population seems to be quite stable, and certainly there are no discernible areas in which cells have degenerated and have been removed.

Pigmentation

Almost every conceivable cytological alteration has been described and associated with age changes (*33*). These alterations are not restricted to any one part of the brain but seem to occur everywhere. Of these, "the most constant element indicating aging in nerve cells is lipofuscin, the lipochrome pigment. It rarely appears in younger subjects, but does appear beyond a certain age. . . . while we can get lipofuscin in some pathologic conditions, the truth is that we can get a great deal of

this material in elderly persons. . . . this is the most important element shown in the cell and that other elements, such as variation in the neurofibrils, Golgi apparatus and, in some cases, the Nissl bodies will have a secondary place" (*35*).

The accumulation of pigment occurs at different time intervals in different regions. Certain nuclei are prone to early pigmentation; others fail to show pigment even in advanced age. It has been suggested that constantly activated cells are less prone to pigmentation, while those that undergo periods of rest or inactivity are more likely to become pigmented during the aging process (*36–38*). In this connection, it is interesting to note that the accumulation of pigment in the nerve cells, as well as some of the other changes with age, are more marked in the human species than in other mammals (*33*).

The Glia

The role of the glia in aging is undoubtedly a very important one, although, except for the phenomenon of satellitosis, with the concomitant process of neuronophagia, little is known about these structures. Studies of satellitosis and neuronophagia of the cortical cells of the human (*39*) and of the horse (*40*) report definite, increasing occurrence with advancing age. In the rat and mouse, satellitosis was not nearly so marked (*41a*). This process also occurs in the brains of young animals and humans, where it may be even more frequent than in the very old individuals (*41a*). No marked qualitative change in glial cell types participating in this process has been reported (*41b*).

Ante-Mortem and Post-Mortem Changes

In the human and in the experimental animal, it is at times extremely difficult to separate the changes which can occur in the cells of the brain before and after death. Post mortem artifacts are real stumbling blocks in neurohistological studies and should not be underestimated. I personally do not contend that nerve cells do not show signs of degeneration, die, and are removed by phagocytosis or lysis. However, I do feel that we must proceed as cautiously as possible in our interpretations of what is normal and what is abnormal in the aging brain.

C. Vogt and O. Vogt (*36*) point out that the time course and morphologic features of aging are different in each of the hundreds of different cell types, and that "the aging process or 'involution' of a cell is different from any regressive process of 'degeneration' it may undergo, but degenerative processes may, of course, occur in combination with an involution. . . . The aging process always leads to the death of the cell. If it occurs at an average (normal) time, it causes partial death of the brain through normal death of the cell type in question. If a person lives sufficiently long, partial death of the vital cells of the medulla causes his or her death, as a normal phenomenon. This form of death is a rare occurrence, because death through disease usually terminates the individual life at an earlier stage." These authors suggest that the aging process may produce counter-reactions, such as hypertigrosis produced by the increased activity of the nucleolus, or hyperchromatosis and pyknosis of the nucleus which has hitherto been wrongly interpreted as a degeneration. This reaction as a defensive or compensatory change on the part of the individual nerve cells may include division of the nucleoli and the nuclei of the cells as well (*33*).

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Physiological Limitations and Age

By JOSEPH A. FALZONE, Jr., M.D., and NATHAN W. SHOCK, Ph.D.

THE PHYSIOLOGY of aging in man rather than age differences in disease incidence has been the chief concern of the Gerontology Branch of the Public Health Service's National Heart Institute. A large body of this latter information is available from other sources (*1, 2*). In the course of our studies, we have found that aging does not affect all organ systems in the same way.

It is obviously difficult to define rigorously what should be called senescence as opposed to "disease." We can only hope to describe changes that occur with the passage of time in subjects for whom all diagnosable disease, which would affect the organ system under study, has been ruled out. To do this, we apply what we call "uniform subject selection criteria" so that other investigators will know what we mean by the phrase "healthy normal subject" and can judge the results accordingly.

The most basic principle of physiology is that the function of most organ systems is to maintain constancy of the internal environment. This is the principle of homeostasis as advanced by Bernard, Cannon, and others. We therefore require three types of information to characterize physiological age differences effectively.

Dr. Falzone and Dr. Shock are with the Gerontology Branch of the National Heart Institute, Public Health Service. The Gerontology Branch, which Dr. Shock directs, is located in the Baltimore City Hospitals, Baltimore, Md.

1. The resting state of the internal environment.
2. The resting organ functions that maintain this state.
3. The reserve or maximal capacities of these organ systems and their ability to defend the internal environment against displacements induced by stress.

The Internal Environment

Under resting conditions, the internal environment is surprisingly well preserved in the older individual as evidenced by lack of change in body temperature (*3*) and levels of various substances in the blood. Thus, Shock and Yiengst (*4*) found that the acid-base equilibrium of the blood is maintained within normal limits in the old man (fig. 1). A slight fall in pH does occur with corresponding, but not significant, changes in CO_2 tension and bicarbonate level.

Arterial fasting blood sugar does not change significantly with age (*5*), but there is some evidence suggesting a slightly higher fasting level in venous blood (*6*).

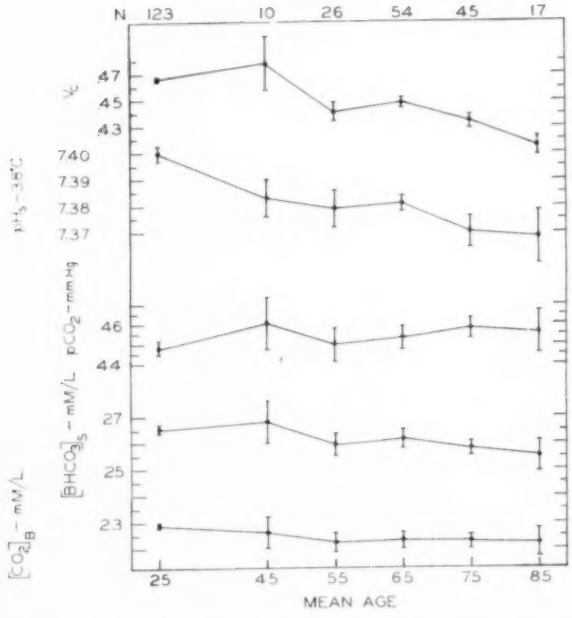
Hematological values of the blood are also well maintained in the aged. Shapleigh, Mayes, and Moore (*7*) determined these values in a series of 100 men and women 60–95 years of age and compared them with previously reported values for healthy young adults. Red cell counts, hemoglobin, and hematocrit values were slightly, and probably significantly, lower in the 60–95-year age group, with a smaller sex difference than in young individuals. Red cell

indexes and reticulocyte counts remained within the normal range, and no definite qualitative erythrocyte changes were seen microscopically. Total and differential leukocyte counts were also unchanged.

Functional Measures

It must be emphasized again, however, that the data described so far tell us very little of function or reserve capacities of the system for meeting the stresses of daily living. For example, if an individual's daily urea production remains constant while some renal insult suddenly reduces urea clearance, his blood urea will gradually rise until the product of blood level and clearance is once more equal to this tissue production rate. This new steady state level of blood urea will then be evidence of impaired renal function. It is also evident, however, that this same individual, if placed on a low protein diet at the same instant as his renal damage, might show no elevation of blood

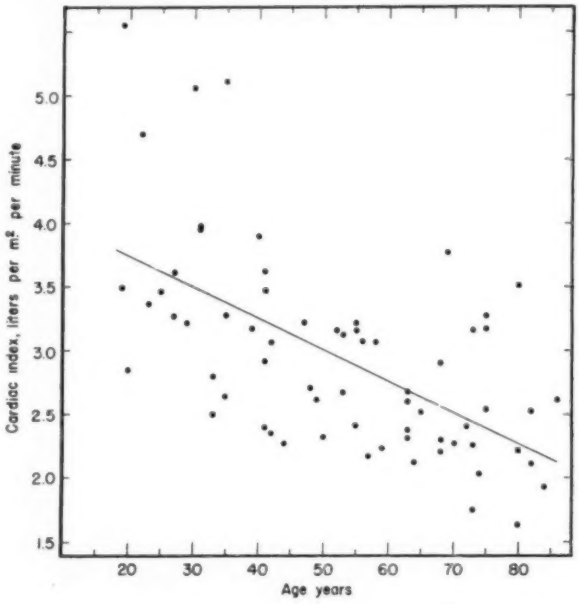
Figure 1. Trends in the acid-base equilibrium of the blood of men with increasing age.



Average curves from top to bottom include percentage of red cells, serum pH at 38° C., carbon dioxide tension expressed in millimeters of mercury, and serum bicarbonate and blood carbon dioxide content, both expressed in millimoles per liter. The vertical lines indicate ±1 standard error of the mean.

SOURCE: Reference 4.

Figure 2. The relation between basal cardiac index (liters per square meter per minute) and age (years) in 67 men without circulatory disorder.



SOURCE: Reference 9.

urea. Theoretically, then, physiological functions and reserve capacities can be reduced enormously without change in the internal environment, under resting conditions. In this regard, many of you will recall patients with a progressive downhill course and eventual death despite an impressive list of normal blood chemistries.

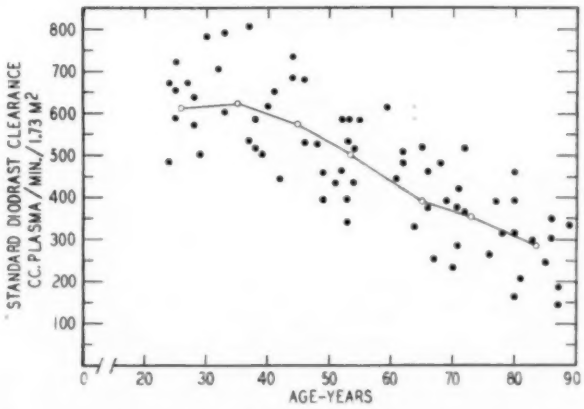
Among functional measures that can be employed, the basal metabolic rate (BMR) is of obvious interest in agewise comparisons. One often hears the suggestion that people "slow down" as they grow older, as evidenced by obvious changes in speech, gait, and cerebration. The ultimate energy source for all of these functions is, of course, oxidative metabolism. Without implying a causal relationship, one might ask if this overall metabolic rate also declines with age, at least under resting conditions. This appears to be the case. Shock and Yiengst (*8*) demonstrated a significant age decrement in basal O_2 consumption whether expressed as total oxygen uptake for the individual or per unit surface area. Expressed in calories per square meter per hour, the decline is from approximately 36 at age 40–49 to 30 at

age 80–89. This is not dramatically large, but it is highly significant and agrees quite well with most other data. Later, we will have reason to question the adequacy of calculated body surface area as an index of the amount of functioning tissue present in the individual. The fact to be emphasized at this point is that oxygen consumption per individual decreases with age.

A decline in resting cardiac output and cardiac index was found in a series of 67 men by Brandfonbrener, Landowne, and Shock (*9*), as shown in figure 2. This, of course, tells us nothing of the reserve capacity of the heart for increasing its output under conditions of exercise. We have recently initiated a study designed to give us this information, using exercise carried to exhaustion as the maximum stimulus to cardiac output.

Pulmonary function, in the aspects we have measured, changes markedly with age (*10*). Thus, total lung capacity (TLC) declines, but in our sample of 140 subjects this is paralleled by a decline in surface area. Total lung capacity corrected for surface area does not change. The compartments of total lung capacity change strikingly, however, with an increase in residual volume (RV) at the expense of vital capacity (VC) and its subdivisions. Thus, there is a shift from mobile to fixed lung spaces. The other large change we have found is in maximum breathing capacity. This falls

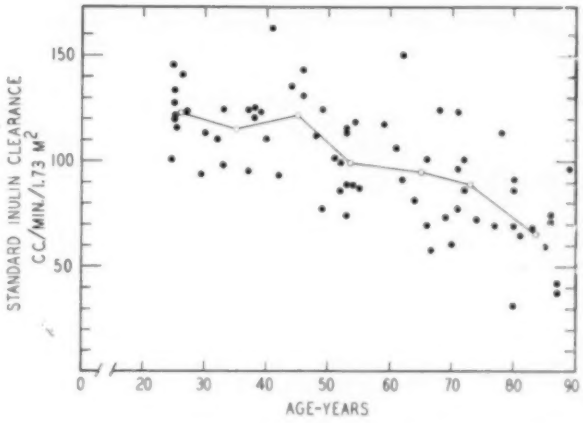
Figure 3. Change in standard diodrast clearance or effective renal plasma flow with age.



○———○ average values, cubic centimeters of plasma per minute per 1.73 m.² body surface area.

SOURCE: Reference 12.

Figure 4. Change in standard inulin clearance or glomerular filtration rate with age.



○———○ average values, cubic centimeters of filtrate per millimeter per 1.73 m.² body surface area.

SOURCE: Reference 12.

from a mean of about 132 liters per minute at age 20–29 to 50 liters per minute at age 80–89. Most of this impairment seen in the older individual is a result of a relative inability to increase respiratory rate under the test conditions.

It may be suggested that our older subjects are suffering from emphysema. Certainly, we cannot distinguish these age changes from emphysema, particularly if an arbitrary value of the ratio of RV to TLC (or VC) is to be the clinical criterion, as it often is. We can only suggest that this common form of emphysema is a relatively constant age change and that the term "senile" emphysema is appropriate.

Of all organ systems maintaining the internal milieu, probably none bears a greater burden than the kidney. The arterial blood reaching the kidneys passes through the glomeruli; of this, about 20 percent is filtered through the glomerular membranes. About 99 percent of this filtrate water is actively reabsorbed by the kidney tubules, together with glucose, amino acids, and electrolytes, while waste products are excreted into the remaining filtrate volume by these same tubules. The external product is urine of variable composition; the internal component, blood plasma of constant composition. Thus, a complete estimate of renal integrity includes measures of the amount of blood or plasma perfusing the kidney, the proportion of plasma filtered, or the filtration

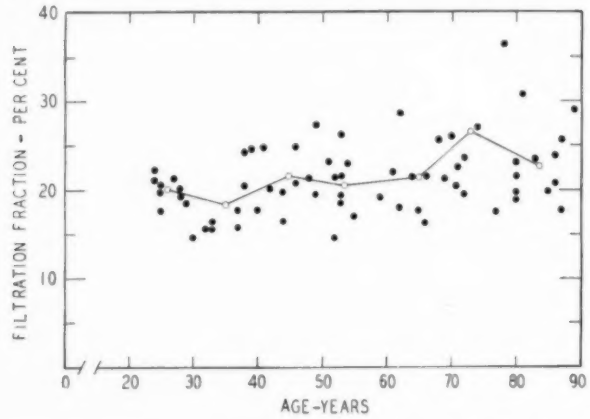
fraction, the amount of glomerular filtrate formed, and the maximum capacity of the tubules to reabsorb or excrete specific substances.

It is found that renal plasma flow, as measured by diodrast clearance, decreases from about 600 cc. per minute in the 20–29-year age group to about 300 cc. per minute in the 80–89-year age group (*11, 12*). Figure 3 shows a scatter plot of these individual values. It may be seen that some of the 80-year-old subjects have values at least as high as some individuals in the 40–50-year age group. One wonders what values these 80-year-old subjects would have shown in their youth. This variability is seen in many other functions and only stresses the need for longitudinal studies in aging since individuals might show stepwise decrements in function.

Glomerular filtration rate, as measured by inulin clearance, also declines with age as seen in figure 4 (*11, 12*). This is slightly less than the decline in effective plasma flow so that the filtration fraction increases slightly, but significantly, as shown in figure 5.

From these data alone, we cannot say whether the reduced plasma flow results from loss of nephrons, reduced flow per nephron, or a combination of these two factors, but the increased filtration fraction would imply a relative increase of efferent to afferent arteriolar constriction. It would also appear that total renal resistance has increased more than total peripheral resistance, since the age decrement in

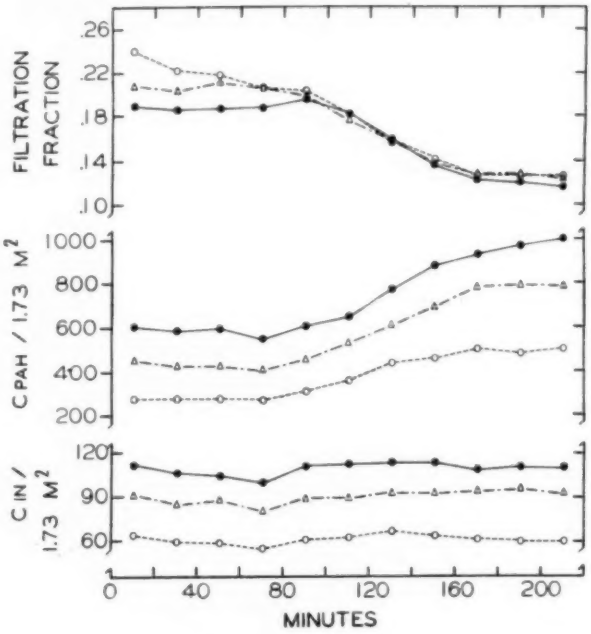
Figure 5. Change in filtration fraction with age.



○———○ average values, percent of plasma filtered.

SOURCE: Reference 12.

Figure 6. Changes in glomerular filtration rate (C_{IN}), effective renal plasma flow (C_{PAH}), and filtration fraction during the pyrogen reaction. Fifty million killed typhoid organisms were injected intravenously at zero time.



○·····○ mean values for 14 subjects aged 70–85 years (O groups).

△—·—·—△ mean values for 20 subjects aged 50–69 years (M group).

●———● mean values for 20 subjects aged 20–49 years (Y group).

SOURCE: Reference 13.

renal blood flow exceeds that in cardiac output (*9*) while mean blood pressure does not fall.

Are the apparent changes in the resistance of the kidney to blood flow the result of unalterable anatomic changes in the arterioles or can resistance be lowered by a physiological stimulus? To answer this question, McDonald, Solomon, and Shock (*12, 13*) tested the effect of a bacterial pyrogen which increases effective plasma flow in young subjects. It was found that effective plasma flow could be increased significantly in all age groups, and that while the absolute baseline and magnitude of increase was smaller in the oldest group the percentage increment was similar to that of the young. The glomerular filtration rate was unchanged by the pyrogen while the filtration fraction necessarily declined significantly to become equal in all age

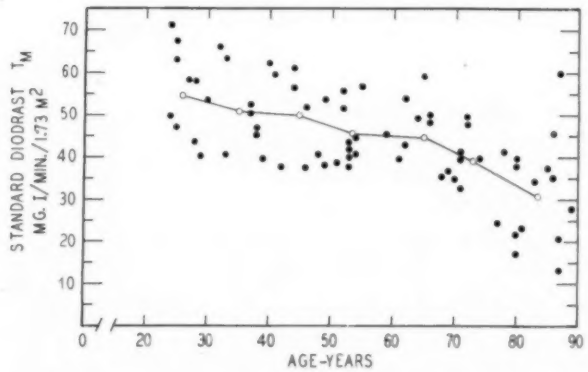
groups (fig. 6). This suggests that a large proportion of the total as well as relative efferent vasoconstriction present in an old kidney is reversible (*14*).

It was also found that tubular function, as estimated by maximum rates of diodrast excretion and glucose reabsorption, decreased with age, as shown in figures 7 and 8 (*11*, *12*, *15*). The magnitude of these decrements is similar to that of glomerular filtration rate (GFR), which suggests that nephrons lose function as a unit. Constancy of the ratio GFR: diodrast T_m is seen in figure 9. The decline in effective plasma flow, however, exceeds any of these decrements, suggesting that vascular impairment is primary rather than secondary to loss of nephron function (*11*, *12*). This relationship is illustrated in figure 10.

Possible Effects on Longevity

What do these changes mean with respect to health, vigor, and life expectancy? They are certainly never listed as cause of death. Yet we may ask if they are in some way related to the unfortunate contour of mortality curves—something happens to the individual with time so that probability of death at any moment is not constant but increases with age. This can be illustrated by the results of renal studies. It is known, for example, that urea and inulin are excreted by the kidney in a similar way except that some of the urea diffuses back into the blood stream. Thus, we would expect urea clearance to show an age effect similar to that of the glomerular filtration rate and also to find some increase in blood urea nitrogen unless an older man's nitrogen catabolism is reduced in a parallel way.

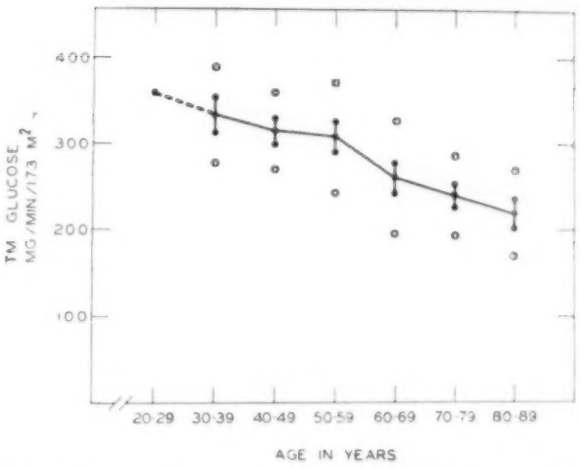
Figure 7. Change in standard diodrast T_m with age.



○———○ average values, milligrams of diodrast iodine per minute per 1.73 m² body surface area.

SOURCE: Reference 12.

Figure 8. Decrease in maximal tubular reabsorptive capacity with age.



The slope is drawn to connect the mean values for each decade. The vertical lines represent ± 1 standard error of the mean, while the open circles define the limits of ± 1 standard deviation of the distribution.

SOURCE: Reference 15.

Studies by Lewis and Alving (*16*) do show an age reduction of urea clearance of about the same magnitude as the fall in glomerular filtration rate as found in our laboratory. An older man's nitrogen catabolism is reduced, but only slightly, and this is not enough to prevent an increase of blood urea nitrogen from 10 mg. percent to 18 mg. percent over a 20–90-year age span. This relationship between blood level clearance rate and production of urea is a simple hyperbolic one, that is, successive constant decrements of urea clearance produce ever larger increments in blood urea.

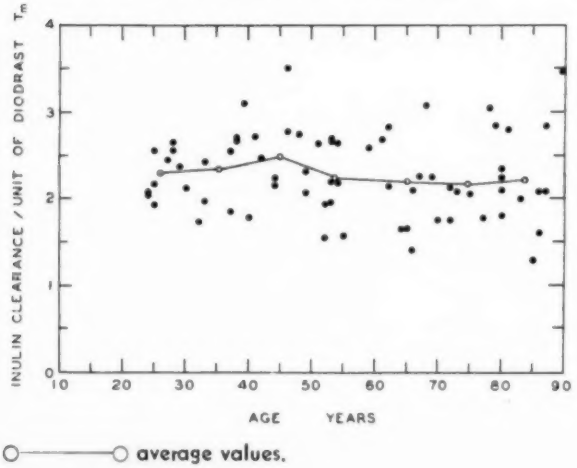
From this and from the Lewis and Alving data, we can make a simple prediction. Suppose that a 20-year-old man suffers some renal insult such as nephritis or ureteral occlusion which reduces his urea clearance by 25 percent. As a consequence his blood urea nitrogen will increase from approximately 10 to 13.3 mg. percent, or a rise of 3.3 mg. percent. This is still within the limits of normal. If, on the other hand, a 90-year-old man suffers the same fate,

his blood level will rise from 18 to 23.9 mg., an increase of 5.9 mg. percent, which is above the normal range. Further renal insults will serve to magnify this difference. Urea itself is relatively nontoxic, but impairment in reserve will make the accumulation of substances in the body more rapid, and the deleterious effects of toxic substances will be more marked in the old man.

It is more difficult to make predictions with respect to pulmonary function. Although the maximal breathing capacity is normally much higher than the ventilatory level attained with violent exercise, it is quite likely that there is a correlation between the two levels, and we have some preliminary findings which support this. However, by making a variety of assumptions with regard to dead space and tidal volume, it can be calculated that ventilation volume per se does not limit the oxygen uptake or exercise performance of an older man until values below 20 liters per minute are reached. As these calculations were designed to demonstrate the effect of ventilation alone, they assume perfect mixing of air in the lungs. Since mixing is not perfect, the age changes in lung compartments we have observed would tend to impair lung transport and thus produce arterial oxygen unsaturation and undue demands upon cardiac output at ventilation volumes higher than calculated. Thus, we see that an impairment in one physiological system places an added burden upon another system whose functional capacity may also be decreased with age. What we have observed so far is that the maximum work rate of an old man is reduced; we are now trying to discover the relative importance of pulmonary, cardiac, or muscular limitations.

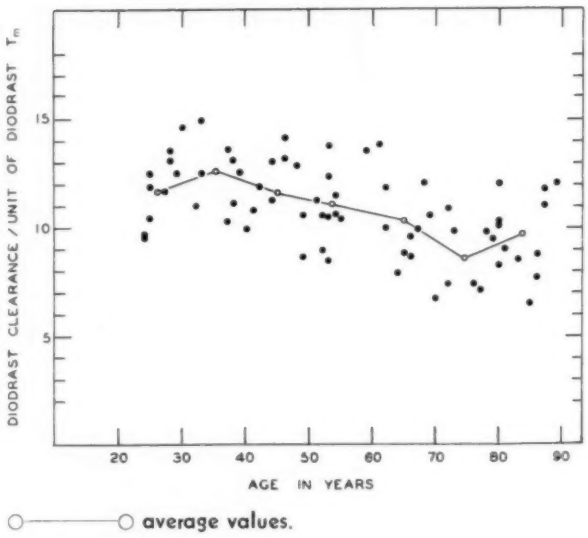
It is also not too difficult to imagine an adverse effect of pulmonary limitations upon life expectancy. For example, an older individual with reduced ventilatory capacity and mixing efficiency is in a far more precarious position with superimposed lobar pneumonia than is a young man.

Figure 9. Change in rate of glomerular filtration per unit of diodrast T_m.



SOURCE: Reference 12.

Figure 10. Change in effective renal plasma flow per unit of diodrast T_m.



SOURCE: Reference 12.

Mechanisms of Aging

We have described some physiological age changes in man, with some possible consequences with respect to vigor and longevity. We must now ask how these changes come about. It is apparent that functional loss in an organ system implies either loss of active protoplasm or qualitative difference in the protoplasm. To estimate the relative importance of these two factors, we obviously need some good index of protoplasmic mass. There is quantitative histochemical evidence that, for a given tissue, protoplasmic composition is relatively constant with respect to water and electrolytes and does not change with age (*17*). Thus, intracellular

water, which can be estimated in intact animals, should serve as a better protoplasmic index than body weight or calculated surface area, which are obviously affected by such nonprotoplasmic materials as fat and edema fluid.

By using the antipyrine space as a measure of total body water and the thiocyanate space as an estimate of extracellular space, the intracellular water may be calculated as the difference between these two. Shock, Yiengst, and Watkin (*18*) found that total body water and intracellular water decrease significantly with age while the extracellular space does not change. Since these estimates were made for the same subjects used in studying the basal metabolic rate, they could be applied as BMR reference standards for each individual. It was found that basal O_2 consumption per unit of total body water or intracellular water does not change with age (fig. 11). This would suggest that, in terms of net metabolic activity, the protoplasm of an old man is unchanged; he simply has less protoplasm (*19*). Morphological studies of a variety of tissues in man support this viewpoint. Thus, a variable weight loss of many organs occurs with age, accompanied by widespread cell shrinkage, cell loss, and relative or absolute fibrosis (*20*).

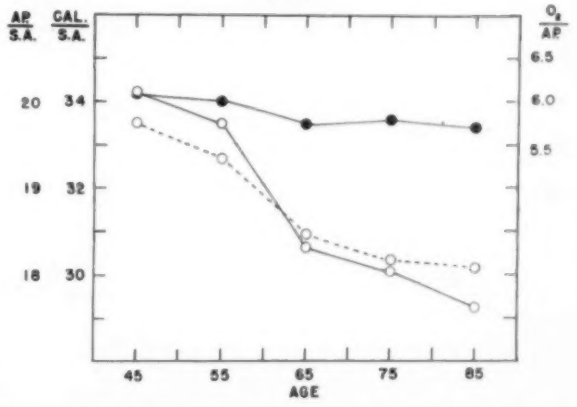
Qualitative cellular changes are equally interesting. Nuclear abnormalities (*21*, *22*) and vacuolated mitochondria (*21–24*) are observed as well as deposition of highly insoluble "age" pigments in heart, brain, and adrenal (*21*, *25*, *26*). Lansing (*27*) has summarized evidence for a loss of cell permeability accompanying increased calcium binding of the cell cortex. The implications of these changes, with respect to cell function, are intriguing, but can we say they are primary changes? We must ask another fundamental question posed by the overall histological appearance of old tissues: Does the intercellular material passively replace cells which shrink or die as they grow old or do the cells die only because they are literally strangled by connective tissue which ages and loses permeability? Or are both altered independently?

In some organs, such as the liver and adrenal, cell shrinkage and loss overshadows fibrosis and might, therefore, be considered a primary factor (*20*). However, the absence of dramatic morphological change in a tissue does not rule out the possibility that subtle alterations, such as reduction in blood flow or permeability, play an important role in aging. In other organs, such as the kidney, parenchymal changes may be secondary results of vascular lesions. It is possible that all of the renal age changes are secondary to progressive arteriolar change (*20*). The fact that the age decrement in renal plasma flow exceeds loss of tubular function would support this view although we can hardly cite it as proof. We cannot be sure that the nephrons would not eventually age in the absence of vascular changes. In short, we have no proof as to the primacy of either intracellular or extracellular changes as the basic cause of aging.

Lansing has summarized some evidence for the hypothesis that aging is a consequence of growth cessation (*27*). His own work shows that longevity of rotifers is inversely proportional to maternal age, that this effect is cumulative through successive generations, and that this progressive shortening of life span first appears when maternal age exceeds the growth phase of this organism. Lines of rotifer, with constant "old" maternal age, were termed "geriaclones" (*27*, *28*).

Experience with tissue culture tends to reinforce this concept, but in a less definite manner. Thus, many cell types show unlimited

Figure 11. Age changes in basal heat production



●——● basal oxygen uptake, cubic centimeters per minute per liter total body water.

○——○ basal metabolism, calories per square meter per hour.

○- - - - - - - - - - ○ total body water, liters per square meter.

SOURCE: Reference 19.

growth potential in vitro (*29*). Even adult human neurones have not entirely lost the capacity for mitosis, as shown by Murray and Stout (*30*). It is of interest that only neurones relatively free of age pigments were observed in mitosis. However, the experience with neurones and other cultures reveals a general antagonism between growth rate and tissue organization (*29–31*). Cell lines with high growth rates may survive indefinitely but show poor differentiation, while slowly growing cultures show more organization but are difficult to maintain. In fact, nonmitotic cells in culture generally live only a fraction of their survival time in vivo so we cannot yet say that they "age" as a consequence of growth lack; they simply do not survive or have not been observed for a sufficient length of time (*29*). Perhaps culture methods can be improved to the point where we can actually decide whether such cells inevitably age in the absence of their normal connective tissue environment. Obviously, this could be most easily tested with cultures from short-lived animals. Neurones from rat and man are morphologically alike, yet their normal life spans differ by a factor of 30. How would their survival times compare in vitro? So far, all we can say is that in vitro the price of immortality is chaos.

Research Needs

The question of primary causes of aging can be answered only by further research on both the human animal and lower life forms. We have studied many aspects of aging in man in the Gerontology Branch, but this field is far from exhausted. As a single example, we have seen that hematological values are only slightly altered with age, but we need information on the rate of replacement of plasma proteins, red cells, and leukocytes. We would also like to know the factors producing the great individual variability we have observed. Why do some 80-year-old men have the physiological reserve of men 30 or 40 years their junior? In this variability lies hope, if we can discern its cause. Longitudinal studies are pertinent to this question. The Gerontology Branch has existed long enough so that we are beginning to gather some of these data on both patients and investigators.

There is, however, information that can only be obtained by animal experimentation, as for example, age changes in tissue composition and enzymatic activity. Such studies on the rat are now in progress in the Gerontology Branch. Some other fundamental researches are best applied to invertebrates, many of which have the twin virtues of uniform genetic composition and very short life spans. The utility of such organisms is illustrated by such excellent studies as that of MacArthur and Baillie (*32*) on the temperature dependence of life span in *Daphnia magna* or by Lansing's work on rotifers (*27, 28*). These two studies jointly raise a curious question. The geriaclone rotifers show, in addition to shortened life span, earlier sexual maturity and accelerated growth rate but smaller final size. These are precisely the four effects seen in *Daphnia* raised at high temperatures. Why this should be so we have no idea, but it is obviously an important clue. It is problems like these which urgently require solution. The questions that face us are difficult, but there is no real reason to believe that they are unanswerable.

Summary

Examination of experimental studies on physiological changes with age indicate that, under resting conditions, the aged human is usually able to maintain uniformity of the internal environment. However, when increased demands are placed on a number of organ systems, impairment of function can often be detected. Thus, the primary characteristic of the older individual is a reduction in reserve capacities which makes him more vulnerable to stresses of even daily living than the young. These changes take place gradually over the entire adult life span and may, in part, be attributed to a loss of functioning tissue. The causes of this loss have not been identified. One of the outstanding characteristics of age change is the striking difference in vulnerability among individuals. At the present stage of research, we cannot identify the factors that determine these individual differences. It is not yet possible to determine the relative importance of loss of functioning tissue and alterations in cellular metabolism in producing the age changes in

physiological function which have been observed. Extensive research, including biochemical, physiological, and histological studies on species other than man will be required to answer these important questions.

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Restorative Services for Older People

The following text was issued in a limited edition as a leaflet for the Federal-State Conference on Aging, June 5–7, 1956, Washington, D. C., prepared by the Hygiene of the Aging Section (now the Health of the Aged Section) of the Chronic Disease Program, Division of Special Health Services, Public Health Service. It is published here to emphasize that many forms of rehabilitation may be constructive, whether or not the patient recovers full physical and economic independence.

There is convincing evidence that a substantial backlog of aged patients for whom restorative services would be appropriate has accumulated in the institutions and communities of this country. All professional workers in the health field should be alive to the opportunity for restoring many of these older people to self-care. The private physician, the health officer, the director of an institution—all should inform themselves concerning the highly significant possibilities in this area.

Restorative services for older people aim at permitting resumption of necessary daily activities by patients themselves through physical and psychological restoration, and at maintenance of maximum self-care by followup procedures. The group for which restorative services are most appropriate is made up of those aged patients who would otherwise be committed to a virtually helpless condition for the rest of their lives, but no disabled patient should be denied services which will maximize his physical and mental capabilities. In certain cases patients not only can be physically restored for daily living so that need for care is reduced, but can, through further rehabilitation, become employable again.

Three questions are significant in this field:

1. To what extent is restoration to self-care possible?
2. What kind of personnel does the job require, and how many?
3. What is the cost of the service?

Results of Restorative Services

Reports on the extent of possible restoration to self-care are not numerous, nor always comparable, but certain salient facts have already been recorded. In England the United Oxford Hospital reported that three-quarters of the surviving patients who received these services were rehabilitated by the end of 3 months. At the District of Columbia General Hospital roughly two-thirds of the patients receiving restorative services returned to the community capable of self-care (including both inpatients and outpatients). At the Allegheny County Home (Pennsylvania) the proportion of patients achieving self-care after restorative services varied from 40 to 70 percent: arthritics, 60 percent; amputees, 70 percent; hip fractures, 60 percent; stroke cases, 40 percent.

Personnel

Ideally, the restorative service team includes: physician director (preferably a physiatrist), psychiatrist, psychologist, physical therapist, occupational therapist, speech and hearing therapist, recreational worker, social worker, nutritionist, and nurse. Few institutions can afford ideal staffing, but much can be accomplished by (*a*) inservice training of the existing staff, (*b*) the addition of a few rehabilitation specialists (either full time or on a consulting basis), and (*c*) the maximum use of community resources. The Allegheny County Home program is a successful example of what can be accomplished through this approach.

Cost

Accurate cost analysis of restorative service programs cannot be made at this time because of variations in cost accounting and in staff and equipment. For example, the District of Columbia General Hospital charged against these services $58,501 for treatment of 883 patients over a 14-month period, an average charge of about $66 per patient treated. On the other hand, the New York University-Bellevue Medical Center estimate for the annual cost of rehabilitation personnel operating a 100-bed restoration service is $104,000 (unpublished data). Each institution must estimate its own costs. It should be noted that the services normally show successful results within 3 months, if success is to be achieved.

In summary, restorative services for older people have been proven to be effective; it has been established that personnel are available or can readily be trained for this work; the cost of the program can be kept within reasonable limits.

On the basis of these facts, it is hoped that early action will be taken in communities throughout the country to initiate these activities.

Finally, it must be constantly emphasized that this problem and this opportunity confront the entire medical profession; restorative services are by no means limited to institutional situations. Wherever old people can benefit by this type of service—in the home as well as in the hospital or the nursing home—the service should be supplied. This is a medical, a health responsibility. It is a challenge to everyone responsible for the health of older people.

Age Changes and Employability

By L. F. KOYL, M.D., D.T.M.H.

THE Department of Veterans Affairs of the Dominion of Canada is comparable to the Veterans Administration in the United States. Among the employees in its Toronto district, it has about 250 persons who are reaching retirement age each year during the fiscal years 1954–64. The facilities of the DVA's 1,800-bed teaching hospital, Sunnybrook, offered an opportunity to study the problems of these aging employees.

In 1954, the assessment unit of Sunnybrook Hospital was publishing data about the problems of the older deteriorating veteran. We requested and were allotted the problem of studying the whole employee in his total environment. Other studies, including an atherosclerosis project and an arthritis study, parallel our work. If the group studying the aging employee detects a problem of interest to any of these groups, their facilities are available to us. Other DVA hospitals in other university centers have special interests under study.

Our terms of reference are:

1. To study a large group of aging employed persons over a period of years to discover the incidence and the rates and direction of change in the various pathological processes accompanying age, including social, economic, medical, and psychological processes.

Dr. Koyl is director, assessment unit, Sunnybrook Hospital, Department of Veterans Affairs, Toronto, Canada, and medical consultant, The de Havilland Aircraft of Canada.

2. To establish a valid clinical method of assessing the aging worker as an individual and of comparing him with his fellows.

3. Therefrom, to establish criteria for continued employment beyond fixed retirement ages.

4. Therefrom, to develop a practical method for examination of the aging employee to determine his suitability for continued employment.

5. To study the rate, direction, varieties, and measurement of intellectual deterioration and to develop practical, accurate, and brief testing procedures.

6. To explore the possibility of correlating clinical evidence of deterioration with laboratory evidence in a practical manner.

7. As a corollary to the above, to study (*a*) the positive prevention of total or partial deterioration in older workers and (*b*) means of keeping older workers working and free from disability.

8. As a further corollary to the above, to study methods of preparing individuals for successful retirement.

We thus began a 5–7-year study, using the multidisciplinary approach, with medicine, psychology, sociology, and economics all involved. We favor placing no limitations on the inventiveness of our members except the tolerance of volunteers to an examination already requiring 6 hours.

It is difficult or impossible to do quantitative analyses on any except the simplest aspects of human behavior, such as chemistry. We therefore had to devise methods of converting qualitative data into semiquantitative data. We

chose functional profiles of our own devising, including the Gulhemp scale. It is important to note the two words "functional" and "profile." A profile can be graphed, machine coded, and so on. If it is a profile of functional ability and is explicit enough, it can be used for job descriptions, employment examinations, and so on.

A most important factor in our work is accuracy of prognosis. We are deliberately making 5-year prognoses when we feel that we have the knowledge to do so and we shall check the accuracy of the prognoses by seeing all volunteers again at 2½- and 5-year intervals. We have already made many repeat examinations for reemployment after age 65 and have been pleased to see that we are very close in our estimates of the type and direction of change in pathological processes. How accurate we are in our estimates of the rate of these changes will not be known for a few months.

Medical Report

There is no real difference in the type of disease found in the working population in this study (median age 61.05 years) and the type found in deteriorating veterans (median age 70.0 years) applying for domiciliary care (*1*, *2*). The difference found is one of degree.

A discussion of preliminary findings follows. The work of our medical and psychology workers is emphasized since reports on the social and economic aspects of the study have been published (*3*).

In only 6 of the 150 volunteers could the diagnosis of "no appreciable disease" be made. However, all were working; therefore, none were truly disabled.

There were 65 fixed disabilities, mostly from wounds, injuries, and operations. Osteoarthritis caused recognizable symptoms and signs in 38 persons. Varying degrees of atherosclerosis were observed in 33 persons, 2 of whom have since died after massive coronary occlusions. Other disease processes were observed in 119 persons. Varicose veins were a problem in 13. Varying degrees of deafness were noted in 33, while 78 had decreasing visual efficiency. There were 8 possible premalignant skin lesions.

Laboratory Findings

In all 150 volunteers, the hemoglobin reading was over 80 percent; the average was 90 percent (15.6 gm. percent=100 percent).

In 24 of 60 cases the sedimentation rate was over 20. Two females were not counted as abnormal because their rates were marginal (22 and 24); in the remaining 22, none of the usual causes of an elevated rate were present.

Results of 24-hour steroid tests on 60 cases were as follows:

Test	*Number cases*	*Range (mg. percent)*	*Average (mg. percent)*	
			60–65 years	*49–59 years*
17 ketosteroids	30	5–15	6.8	6.8
Crude corticoids	29	1–3	1.7	1.8
	1	3.8		

The frequency of abnormal sedimentation rates is interesting. Possibly emotional stress due to the prolonged examinations caused this abnormality. Two-thirds of all abnormalities were recorded at 4:00 p. m., after the volunteers had been under emotional tension for 6 hours.

The lack of correlation of steroid values with age is contrary to the findings of previously published studies on hospitalized groups. The studies on sedimentation rates and steroid values will be continued and coordinated. It will be necessary to obtain electrophoretic serum protein studies on a group with abnormal sedimentation rates plus adrenal steroids and, possibly, C-reactive protein studies.

Physical Findings

General physique is the most important determinant of general employability as distinct from fitness to engage in a specific occupation. The accompanying frequency distribution chart (fig. 1) illustrates this aspect of fitness for continued employment. An artificial cutoff (except for one case) in the number of persons over 65 years of age is included in this early stage of the survey. This cutoff will disappear as we reexamine our increasingly large sample at intervals of 2½ years.

In the top half of the chart, which shows the results of examinations, there is no slope to the mean or median lines. There is no evidence, therefore, of correlation between age and general physique in the limited sample aged 50–64 years.

Our estimates of probable change are plotted in the lower half of the chart. It will be noted that age plus 5 years is the abscissa so that the overall pattern is comparable in the two halves of the chart. The artificial cutoff now occurs at age 70. The sharp bends from G5 to G6 and from G6 to G7 are obviously due to the small samples at G6 and G7. Otherwise there is a slight angulation toward the right in both mean and median lines. Such angulation to the right suggests decreasing fitness with increasing age. The standard deviation of G1 is 3.5, which makes this suggestion probable as the mean curve moves to the right at least 7.1 points relative to G1 between G1 and G5.

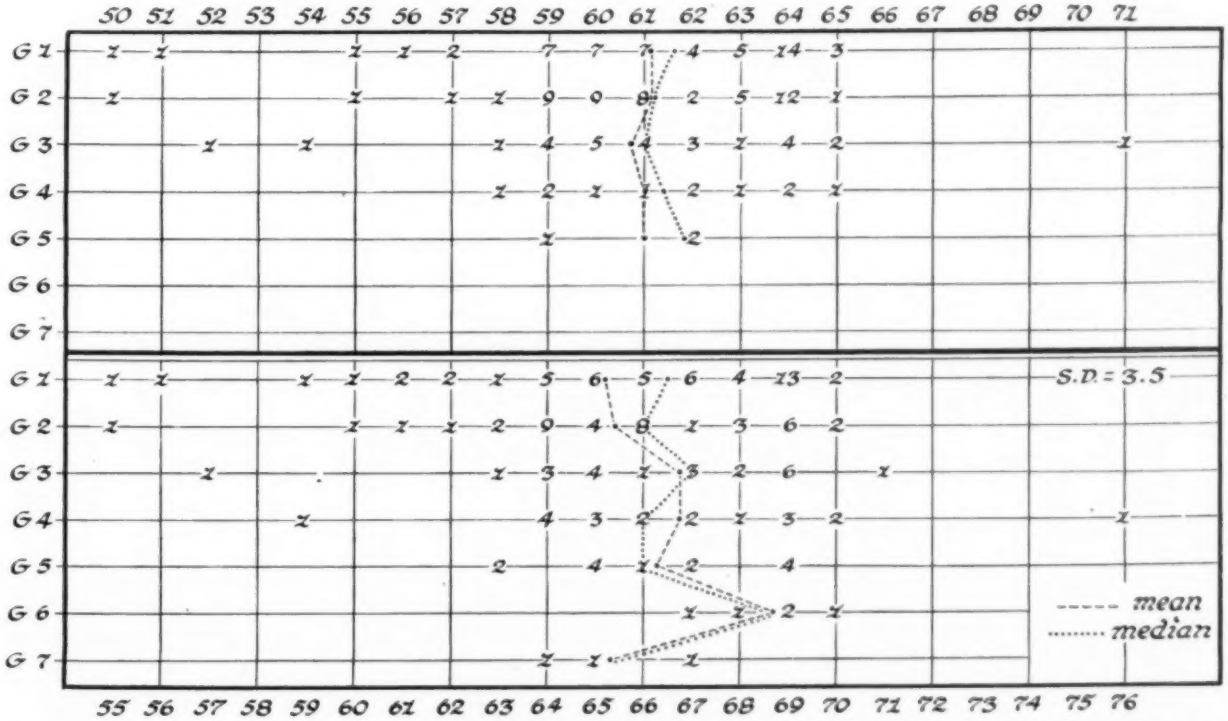
The number and degree of the pathological processes going on in the middle-aged employee will be no surprise to the practicing physician, although the universality of these processes may be surprising. They become evident gradually in the forties so that the rate of deterioration in health is a straight-line curve to the late sixties. Health begins to deteriorate more rapidly as the seventh decade approaches.

Psychological Report

Some Aspects of Intelligence

The calculated intelligence of the volunteers and a clinical prediction of the rate of change is shown in figure 2. The prediction in the lower half of the chart is based on clinical evidence from the various types of disease already present and otherwise is based on the pre-

Figure 1. General physique of 150 employees of retirement age. Upper half, results of examination; lower half, estimated probable changes.



Courtesy of Sunnybrook Hospital, Department of Veterans Affairs, Canada.

G1 Fit for heavy manual work, including digging, lifting, climbing, regularly as main occupation.

G2 Fit for manual work, including incidental or occasional heavy work as in G1—can work on shifts.

G3 Fit for all employment except heavy labor, liable to deteriorate if meals and rest inadequate.

G4 Fit for sedentary employment with regular hours for meals.

G5 Fit for restricted employment or part-time employment. "The handicapped worker" in home or out.

G6 Self-care only.

G7 Bedfast.

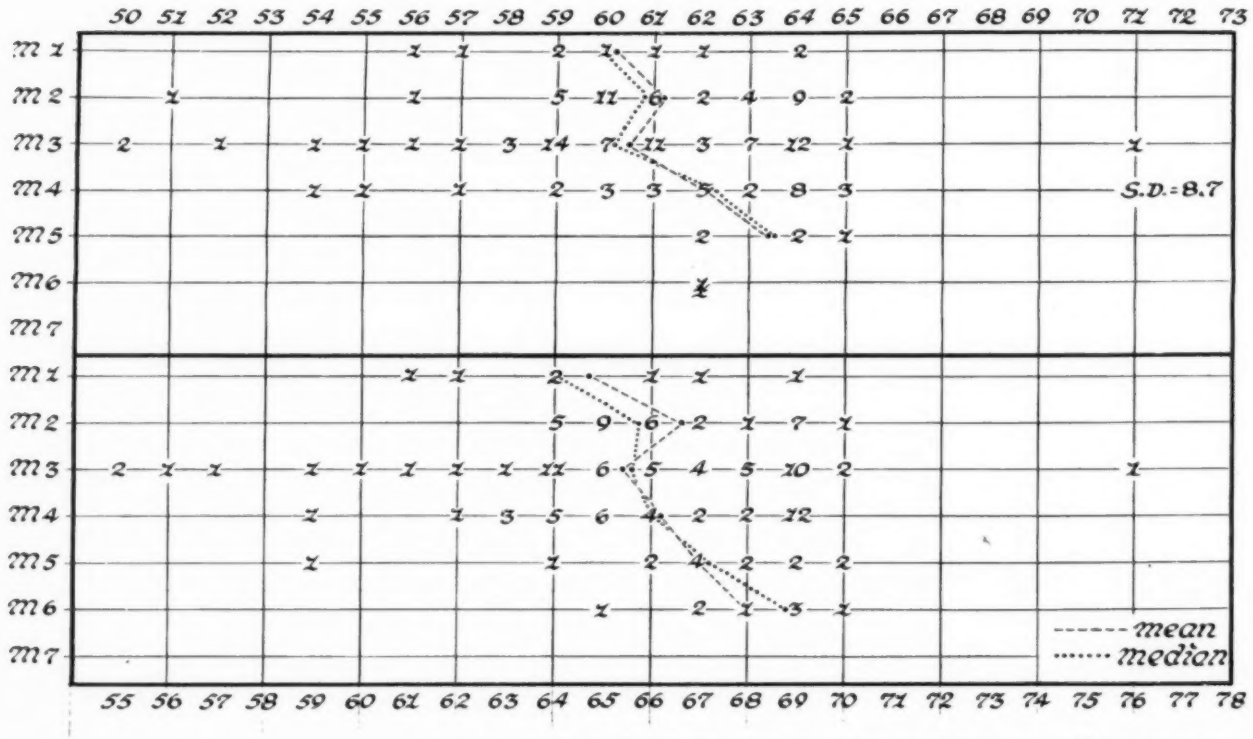
vious experience of the authors. Intrapolation of results was also possible because the procedures had been tested on younger and fitter, as well as on older, more deteriorated groups before beginning this survey.

In both upper and lower halves of the chart, both median and mean lines curve sharply to the bottom right. The standard deviation of M4 in the top half of the sample is noted to be only 8.7. This is probably significant. In terms of M4, the change between M3 and M5 is 11.4.

In this sample, intelligence probably begins to deteriorate at between 50 and 65 years of age. If our predictions are valid, deterioration will continue at approximately the same rate in the following 5 years. (The slope of the "examined" and the "predicted" mean lines are the same.)

There is little or no correlation between de-

Figure 2. Mentality of 150 employees of retirement age. Upper half, results of examination; lower half, estimated probable changes.



Courtesy of Sunnybrook Hospital, Department of Veterans Affairs, Canada.

M1 Intelligence of a superior order capable of understanding and undertaking long-range planning, organization of details, integration of different aspects of a plan; flexibility and individual initiative. I.Q. 140–129.

M2 Intelligence sufficient to plan and carry out work accurately without supervision. Knowledge of job's relationship in broader setting and ability to assume and execute responsibility under supervision. Capable of working accurately under pressure. I.Q. 128–110.

M3 Intelligence sufficient to work accurately under normal supervision and normal conditions. Capable of learning new skills as required. Skilled labor. Normal intelligence. I.Q. 109–91.

M4 Intelligence sufficient for simple routine tasks under supervision, can learn related tasks. Semiskilled and labor. Dull normal intelligence. I.Q. 90–80.

M5 Requires extra supervision due to slowness and failure to understand. Unskilled labor. High-grade defective. I.Q. 79–70.

M6 Requires almost constant supervision and direction at each stage of work. Learning ability poorly demonstrated. Constantly supervised labor. Moron. I.Q. 69–60.

M7 Unable to understand nature of job or remember steps in an operation. Unemployable in any capacity. Imbecile and idiot. I.Q. 59–0.

Table 1. Summary of Wechsler-Bellevue performance

Subtest	Number of cases	Range [1]	Mean [1]	Standard deviation of mean	Rank	Median [1]	Correlation coefficient (R) with I.Q.
Information	149	4–18	11. 17	2. 72	2	10. 72	0. 784
Comprehension	148	4–16	10. 61	2. 59	3	10. 31	. 679
Digit span	147	2–17	9. 12	3. 36	7	9. 06	. 624
Arithmetic	148	1–18	9. 73	4. 38	6	8. 96	. 787
Similarities	149	1–17	9. 02	3. 37	9	8. 75	. 802
Vocabulary	148	6–17	11. 86	2. 61	1	11. 84	. 812
Picture arrangement	149	1–14	7. 77	2. 86	10	6. 92	. 686
Picture completion	149	3–14	10. 03	2. 47	4	9. 45	. 685
Blocks design	149	1–16	9. 08	3. 33	8	8. 53	. 836
Object assembly	149	0–16	9. 87	3. 30	5	10. 32	. 668
Digit symbol	146	0–15	7. 25	2. 37	11	6. 46	. 678
Intelligence quotient:							
Full	148	79–143	113. 79	13. 11	.....	114. 80	.....
Verbal	148	76–139	111. 35	12. 45	.....	111. 50	.....
Performance	148	89–144	118. 46	11. 74	.....	118. 71	.....
Deterioration quotient	146	−68%–+57%	+1. 98	19. 95	.....	+1. 83	−. 436
Efficiency quotient	147	55–134	98. 37	16. 07	.....	100. 32	.....

[1] Weighted score.

terioration in intelligence and organic brain damage. Only five cases had clinically perceptible brain damage and, therefore, organic deterioration. In 122 cases, beginnings of functional deterioration were determined by psychometric or clinical methods of observation, or both.

The average I.Q.'s of the 148 subjects on whom complete Wechsler-Bellevue tests were done are shown in table 1.

Manual ability has not deteriorated to the expected extent in these subjects. The age credits for this need revision.

There was an inverse relationship between the deterioration quotient and intelligence. Exactly one-half of the subjects showed the expected deterioration; 32 percent showed more deterioration than expected and 18 percent, less than expected.

The deterioration quotient as presently calculated is only of qualitative value. The "hold-don't hold" formula needs revision. Some of the "hold" items for example, require sensory acuity of a degree which is not usual for this age group.

Rigidity is an outstanding characteristic of these subjects, especially when thinking at an abstract level is required. Our volunteers had difficulty in tasks requiring concentration or a focus of attention. In some, considerable tension was generated by such requirements.

We would prefer to use efficiency quotients as a standard instead of intelligence quotients, but we are not sufficiently sure of the true meaning of the efficiency quotient.

Some Aspects of Personality

The distribution pattern of the personality types of our volunteers as recorded at the weekly meeting is shown in figure 3. The predicted rate of change shown in the bottom half of the chart is based on clinical knowledge of the usual rate of change in known syndromes as seen by experienced observers. Ages have been offset by 5 years to allow direct comparison of the slope of the means.

The difference between P1 and P2 in the top half of figure 3 is undoubtedly due to the smallness of the sample. Otherwise there is no visible slope to the mean or median line. If our predictions are valid, there is a slope downward and to the right in the half of the chart which represents our 5-year predictions. To test the importance of this trend, the standard deviations of P3 and P4 were calculated. The CR difference calculated from these is 1.75, which is at the 5 percent level of confidence.

It is safe to say, therefore, that there is no significant deterioration in personality in this group in the age range 49–59 years. If our predictions are valid, there will probably be deterioration in personality in the sample at a

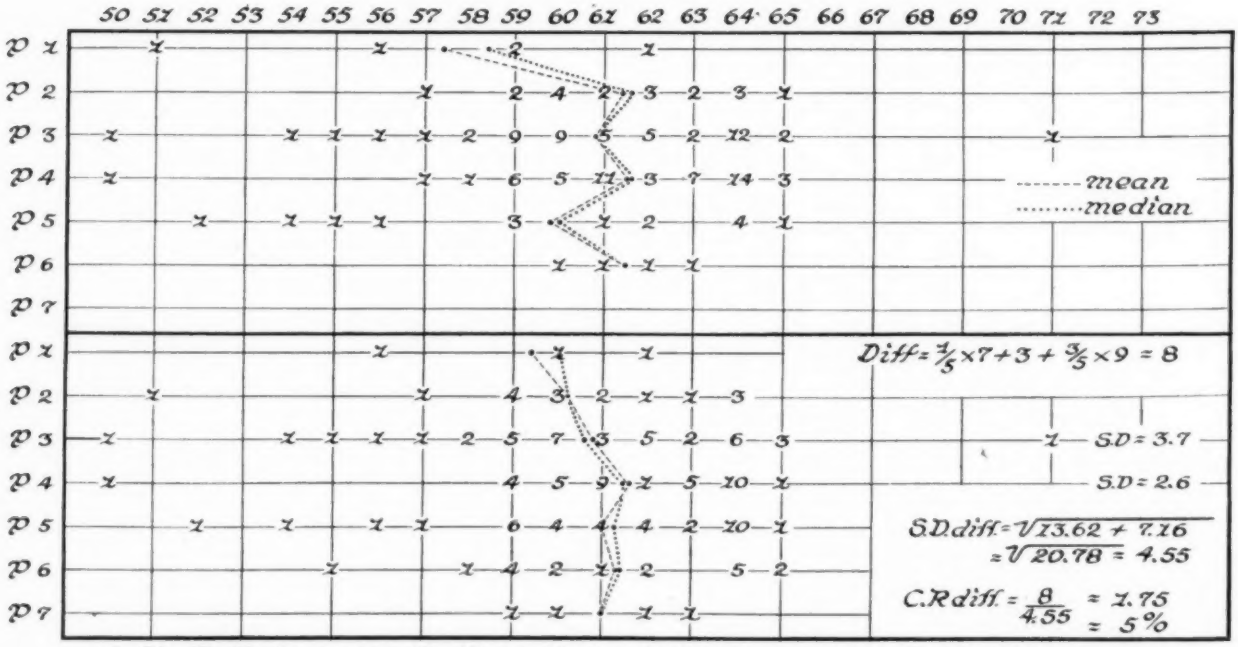
statistically significant rate in the group aged 65–70 years (1 man aged 70).

The personalities of our sample are a cross section of their age group. It must be emphasized that all these employees are earning their living and are therefore "normal." Any other criteria of normalcy are rather unrealistic in this far from perfect world.

To facilitate future study, the reaction pattern of each person was determined. The group was then subdivided according to predominant reaction (table 2). Such a subdivision is inevitably rough since the higher the personality and intelligence rating, the more difficult it is to classify an individual. In 32 cases, the attempt was abandoned.

The dominant personality type of each volunteer was determined clinically. At the weekly conference of examiners, the personality of each person in the study is, of course, the subject of group discussion. Each examiner brings to the conference information of value. Some volunteers talk well to the doctor; others become expansive and confidential with a financial officer; others, whose basic desires are battened down under fairly secure hatches, disclose more to

Figure 3. Personality of 150 employees of retirement age. Upper half, results of examination; lower half, estimated probable changes.



Courtesy of Sunnybrook Hospital, Department of Veterans Affairs, Canada.

P1 Personality sufficiently stable to work with others in supervisory or administrative capacity; capable of earning cooperation of co-workers and respect of his abilities. Flexibility in interpersonal relationships and understanding of problems of the job, loyalty to organization.

P2 Personality sufficiently stable to work well with others and willing to assume partial administrative or supervisory responsibilities if required. Capable of taking direction without rancor.

P3 Personality sufficiently stable to take constructive criticism or advice. Cooperation with others without need to be on the defensive. Self-reliant.

P4 Personality shows signs of doubting own ability, hesitancy, and "tentative" attitude. Requires encouragement and support. Capable of cooperation with others.

P5 Personality shows signs of cracking under pressure of work criticism or staff changes and moves. Manifest in withdrawal or agitation or both.

P6 Personality shows signs of poor or defensive interpersonal relationships with overt criticism of others and difficulty in work relationships.

P7 Personality chronically shows signs of tension, anxiety, or withdrawal sufficient to disrupt work efficiency and interpersonal relationships. Severe neurotic or prepsychotic.

Table 2. Reaction patterns of 150[1] "normal" personalities

Type of dominant characteristic	Total with dominant characteristic	Type of additional characteristics[2]									
		Schizoid, introverted, seclusive	Paranoid	Withdrawn	Rigid, stereotyped	Dependent, passive	Active, impulsive, aggressive	Psychopathic	Hysterical	Depressed	Anxious
Schizoid, introverted, seclusive	23	xxxx	4	7	8	5					10
Paranoid	4		xxxx		2	1					3
Withdrawn	14			xxxx	3						6
Rigid, stereotyped	24			4	xxxx						16
Dependent, passive	2					xxxx					2
Active, impulsive, aggressive							xxxx				
Psychopathic	15		1		4	3	7	xxxx			6
Hysterical									xxxx		
Depressed	14				2	1				xxxx	11
Anxious	17				2	3			2		xxxx

[1] Less 32 too normal to categorize readily, although some showed early signs of slipping, and less 5 with organic deterioration.

[2] Figures indicate number who have these characteristics in addition to dominant characteristic.

the psychologist, who uses tests such as the Rorschach which do not use direct questions. Fairly strong motives are discovered best by such techniques, especially if they are contrary to the principles of action of the integrated patient. Even negative information, such as gaps in work histories, are valuable clues to personality. The composite picture obtained can be translated into the jargon of any profession.

Our psychologist used two unstandardized tests of her own devising to assist in sorting out the personality patterns of this age group. They were an adjective list descriptive of optimistic and pessimistic mood states and a sentence completion test consisting of 60 phrases all beginning with "I" or "My." These have been useful with volunteers but, as practical instruments in an industrial situation, they are subject to evasion, although they would be useful in specific instances.

Our volunteers were very modest about their intellectual endowment; 74 percent specifically denied being clever. They were very free in admitting emotional upset; 53 percent claimed to be chronically tense and anxious. About one-third feel insecure, that they are slipping in their work, are growing more seclusive, and have a lowered frustration tolerance. The lack of structure of the sentence-completion test threw them on their own resources and was too great a challenge for some, resulting in confusion, superficiality of response, or inability to respond.

The Rorschach test is an extremely useful tool for testing individuals in the older age groups. Unlike younger groups, the older person does not accept or enjoy the challenge of this test, and the lack of a defined structure produced confusion, anxiety, and self-doubt. The majority of the volunteers were unable to handle the intangible or the abstract. They were sure there had to be a "right way" to solve the test. In almost all the records, there was a hint of this superficiality and rigidity. In some, it was predominant. When the patterns were emotionally stimulating, there was actual withdrawal with overt tension.

Conclusions

1. We have developed methods of assessing older employees which, within 2–5 years, by deletion and rearrangement, can be made practical and economical for industry. By that time, the substitution of a disability retirement plan for a fixed-age retirement plan should be medically feasible and sound efficiencywise. The economics of such a plan need further

study, as do the precise limits of its applicability.

2. Functional deterioration in mentality and personality antedate and overshadow organic deterioration. Rigidity and withdrawal particularly should be susceptible to preventive methods.

3. The increasing rigidity of the aging employee makes large retraining schemes in industry uneconomical, except where an absolute shortage of a skilled trade exists, and suggests that the routine retention of rigid senior executives is unwise.

DOCUMENTATION NOTE

Copies of the Gulhemp scales have been deposited as document No. 5063 with the American Documentation Institute, Photoduplication Service, Library of Congress, Washington 25, D. C. A photoprint copy may be obtained by remitting $2.50; a 35-mm. microfilm copy by remitting $1.75. Advance payment is required. Make checks or money orders payable to Chief, Photoduplication Service, Library of Congress.

Copies of the scales may also be obtained from the author.

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(*2*) Koyl, L. F., Laurence, M. W., and Monkhouse, H. B.: Domiciliary care at D. A. V., Toronto. Second report. Canad. Serv. M. J. 10: 313–339, December 1954.

(*3*) Koyl, L. F., Cross, E. G., Laurence, M. W., Monkhouse, H. B., and Holloway, R. D.: Employees' health study. First progress report. Canad. Serv. M. J. 12: 317–334, April 1956.

Still Going Places

Active Management of Disability in the Aged

16 mm., black and white, sound, 1,450 ft., 40 minutes. 1955.

Audience: All physicians, especially specialists in physical medicine and rehabilitation.

Available: Film Library, Pfizer Laboratories, 630 Flushing Avenue, Brooklyn 6, N. Y.

A medical documentary film, written and directed by George C. Stoney in collaboration with Frederic D. Zeman, M.D., and Leo Dobrin, M.D., of the Home for the Aged and Infirm Hebrews of New York, this film demonstrates practical ways in which chronically ill or acutely disabled patients of advanced years can be helped to live useful, self-sufficient lives.

A wide range of examples is shown, each underlining the basic principle of active management: "by promoting movement one preserves the ability to move."

Workshops and Seminars

Highlights of workshop sessions at the Ann Arbor conference are reported by representatives of the Public Health Service. In addition the chairman of the Committee on Aging reports the recommendations of two seminars on professional training.

The Geriatric Clinic

Personnel from a geriatric clinic in New York City and from another in Florida presented their respective programs as a basis for discussion. One presentation emphasized the role of the geriatric clinic in the hospital, and the other, the role of the clinic in the community.

Such demonstration programs serve as teaching centers in geriatrics. They furnish information on the problems of the aged for their communities and provide other communities with useful information about managing the special needs of the aged.

Experience in these clinics has taught that, though the initial steps of performing a thorough examination and working out the plan of individual medical care are time consuming, they greatly reduce the time spent in maintaining patient care.

Special consideration to the needs of the aged may be given in a comprehensive care clinic or in a geriatric clinic. In either place, someone whose competence and attitude is oriented toward care of the aged should direct and coordinate the program.

Many agencies and professional workers believe services to the aged should be complete. Cooperation of the many agencies concerned, with a major guiding influence, would permit such complete services to be realized with economy.

—MARTHA BALL NAYLOR, R.N., B.S., M.P.H., *chief nursing consultant, Chronic Disease Program, Division of Special Health Services.*

Housing and Long-Term Care

Discussions on housing by a group of physicians, nurses, hospital administrators, housing experts, and representatives of nursing homes were vigorous and enlightening.

They agreed on the following points: Those who are ill require medical care and nursing home facilities. Low-cost housing is a pressing necessity for the well or almost well, with varying degrees of homemaking service. Coordination between agencies that provide medical, welfare, and recreational services to the aged should be improved. Housing for the aged should not lead to regimentation or decrease the individual's independence. The aged should not be segregated. Integration with young people in housing projects should be encouraged.

They agreed that community surveys were necessary to indicate community needs and resources. The survey data, objectives of the facilities, and requirements for major equipment and employees in each area will provide the architect with the information necessary to appropriate design and construction. "Form will follow function."

They agreed that housing or long-term care facilities for the aged should be located in pleasant surroundings and should be accessible to visitors and employees. The availability of utilities and public transportation is of prime importance. The physical plant should be of

sufficient size to be operated economically. The possibility of future expansion should be kept in mind. A homelike atmosphere should prevail. Safety features should be included. Dark and congested areas should be avoided.

Staffing and programing of facilities for oldsters will depend on the size, number, and extent of medical and allied services in the area. Additional allowances must be made for administrative and maintenance service.

It is evident that new money is required to pay for personal health services. Redistribution of existing expenditures will not be sufficient. Old-age and survivors insurance is one source of funds available to the aged. Voluntary insurance is popular with many, but there is need to expand present voluntary insurance to include major medical contracts, home nursing, convalescent home care, appliances, drugs, and so forth.

—DANIEL J. DALEY, M.D., *assistant chief, Division of Hospital and Medical Facilities.*

Criteria for Retirement

A review of different types of retirement plans led to the quest for suitable criteria for retirement.

Chronologic age as a criterion for retirement is considered unsound economically and socially, having no relation to the nature of the worker's job or to his ability to perform his work. A retirement age should be determined by the health and performance of a worker. Retirement should be related to capacity and ability to perform gainful work. The goal in each individual instance should be to maximize employability. There is no evidence to substantiate the allegation that it is difficult to administer selective retirement.

Much research is needed on physiological age and other debated criteria for retirement. The practice of preparing employees for retirement should be adopted more widely. In described examples of this practice, emphasis is placed on annual physical examinations, annual talks on retirement plans, and frequent review of attendance history, production, attitude toward job, and present and previous health records. When review discloses deficiencies, part-time employment is suggested.

Aging workers need, among other things, training and retraining facilities, community placement services of adequate size and composition, and well-supported educational opportunities.

—WILLIAM M. GAFAFER, D.Sc., *technical adviser, Occupational Health Program, Division of Special Health Services.*

Financing Health Services

The problem of meeting the cost of medical care for the aged was considered so important a facet of their health care that one of the three general sessions of the conference was devoted to this topic.

A spokesman for the private insurance companies said that in due course private effort would meet the problem. The private companies have already developed new types of policies for the aged. He noted that employers were working toward providing health insurance benefits for retired workers.

A representative of the United Automobile Workers held that the greater health needs of the aged, combined with their low financial resources, made it impossible for private insurance companies to provide adequate coverage. The solution lay, he believed, in expanding old-age and survivors insurance to provide hospitalization benefits, and presumably later, medical benefits to retired workers.

The workshop sessions on insurance methods for meeting the medical costs of older people were largely concerned with the present activities and accomplishments of Blue Cross-Blue Shield, insurance companies, and cooperative health plans in providing health insurance coverage to the aged.

A representative of the Michigan Blue Cross plan described in detail his plan's provisions for carrying retired employees including arrangements whereby they are carried as members of the employee group, receiving the same benefits at the same costs as active employees. Representatives of the insurance companies told of individual health insurance policies they have developed, including policies which are

paid up at age 65 and others which are noncancelable and on which the company can raise the premium only if it does so for all policyholders of this class.

There was rather common agreement that arrangements are needed for funding the increased cost of health care for the aged over the individual's working life or of spreading the extra cost of health services for the retired among all active employees. Insurance company representatives felt that there was no problem about covering employees over age 65 who are still working or retired workers who are receiving pensions, and they believed means could be developed for including retired employees in a company's group insurance program. They felt that the problem of health insurance for low-income aged persons was but a special aspect of that for all persons who have incomes too low to enable them to purchase insurance.

Recommendations proposed at the concluding session of the workshop ranged all the way from having private carriers press forward with their vigorous efforts to provide health insurance coverage to the aged, to provision of hospitalization benefits as part of the Federal Old-Age and Survivors Insurance program.

—Louis S. Reed, Ph.D., *health economist, Occupational Health Program, Division of Special Health Services.*

Implications for Nursing

Physicians laid the groundwork through discussions on the physiological and psychological age changes and on helping the older person be independent.

Three nurses spoke on the implications for nursing in helping the older person to independence. One described the rehabilitation program of the Visiting Nurse Association of Allegheny County in Pittsburgh and exhibited self-help devices which the association has available for loan. One emphasized the need to examine hospital practices, attitudes, and mores, stating her belief that in many instances these meet the needs of the hospital and its personnel rather than those of the patient. One briefly pointed out general implications for nursing, relating them to the discussions on physical and mental health at the Federal-State Conference on Aging in Washington, D. C., June 5–7, 1956 (see page 1209).

—Esther Kaufman, R.N., B.S., *public health nursing consultant, Chronic Disease Program, Division of Special Health Services.*

New Careers in Gerontology

Preparing medical students and professional workers for dealing with the diseases and disabilities of old age was the subject of a seminar on geriatric medicine conducted by Dr. E. V. Cowdry, director of the Werle Cancer Clinic, Washington University Medical School, and a second seminar conducted by Clark Tibbitts, Department of Health, Education, and Welfare, at the Ann Arbor Conference on Aging.

Other professional occupations associated with gerontology include professors of social work and public health, educators, State officials, administrators of old-age homes, caseworkers, vocational rehabilitation workers, and counselors.

The seminar on geriatric medicine included senior faculty representatives of 10 medical schools as well as the Veterans Administration and the Public Health Service. A spirited discussion quickly brought general agreement that departments of geriatrics would be unwelcome additions to medical schools. It was also agreed that the schools must focus increasing attention on the problems of the aged. Students need to develop a more wholesome attitude toward this group of complex patients. Research needs to be intensified.

Although it is recognized that the faculty of each medical school will make its own arrangements, a coordinator for aging is needed to act as a focal point for activities related to aging.

The coordinator could be in any medical school department although most often he would be in the department of internal medicine. He would head an interdepartmental committee concerned with incorporating appropriate material on aging into the curriculum content of each department. He would spark research and would serve as liaison officer with

the general university. It is vital that he have full financial support and control of an adequate budget.

Graduate departments should be organized to train investigators and teachers in geriatric medicine, the seminar indicated. It was agreed that large numbers of geriatricians are not required for service programs since medical care of older people is the legitimate province of the internist and the general practitioner.

Although the second seminar was exploring a relatively uncharted field when it considered professional training for gerontology, it was able to reach several major conclusions.

For example, it was agreed that middle age and old age are identifiable periods of life, having characteristics that should be studied in all of the life science and social science courses given in secondary schools and in colleges and universities.

Equally general was the agreement that gerontology is a science in its own right and that all professional persons planning to work with older persons should have specialized training throughout their preparation in didactic instruction and fieldwork.

This seminar identified three principal occupational categories calling for specializing in work with older persons: the professional occupations such as social work or adult education, related occupations having some involvement with older persons, and generalists in aging.

The generalist was defined as an individual who has a broad knowledge of the characteristics, needs, and circumstances of aging and older people; understanding of aging as a social, cultural phenomenon; knowledge of community organization and resources; and skill in working with individuals and groups. His training should draw upon the biological, psychological, and social sciences at the graduate level.

Generalists are employed as community and State coordinators in aging, administrators of old-age homes, specialists in voluntary and governmental agencies, and executives of university programs. As awareness of the expanding field grows, the number of places open to generalists is expected to increase rapidly.

As to the administrative location of gerontology training in a university, the seminar leaned toward establishment of a new department or institute that would offer core courses in gerontology combined with elective courses in related departments.

—CLARK TIBBITTS, *chairman, Committee on Aging, Department of Health, Education, and Welfare.*

Health Assessment of the Aged

Guidelines for health evaluation of aged patients were matched against experience in a wide variety of settings. These included clinical and group practice, special studies, retirement communities, and industrial health services as well as a public assistance program for periodic evaluation of nursing home residents, a geriatric clinic, and a rehabilitation program in a county home.

There was agreement that assessment of the aged person's health must be a total evaluation of his physical, psychological, and social state as well as his potential response to restorative services. Each discipline described not only its function in evaluation of current status but also what it could contribute to restorative services. Evaluation was seen as a continuing process rather than as a single-shot verdict.

There also was agreement that we have few controls against which to evaluate the physical, emotional, and social status of aged patients.

Throughout the discussion, the lack of standards or adequate tests for the aged was a recurrent theme. Hypertension in the aged was described as a relatively benign disease, usually overtreated. Internists commented that many symptoms in aged patients do not have the same significance they would have for the young. They described marked discrepancies between findings at autopsy and the functioning ability of a person immediately before death: Many functioned well despite severe physical handicaps; others functioned poorly although their physical condition appeared to be relatively sound.

Psychologists commented that tests which have been developed for adolescents and young adults do not apply to the aged. For example, a psychiatrist described an engineering pro-

fessor approaching retirement who made a poor score on blocks and numbers tests but who was brilliant at explaining abstruse differential equations to graduate students. He had passed so far beyond elementary skills that he no longer had use for them. Another psychiatrist commented that dreams of the aged have quite different interpretations from those of the young.

Social scientists described changes in responsibilities, roles in the family and community, and expectations of the aged. Social workers described differences to be considered in offering service to the aged, for example, the possible need for shorter, more frequent, and perhaps more continuous contacts by whoever is offering service.

A point of complete agreement was the importance of considering patients' functional ability and potential, with emphasis not on what had been lost but on what remains or can be restored. Also of prime importance are a hopeful attitude on the part of staff working with the aged and the factor of hope in the aged person himself.

—ELEONOR MORRIS, M.S.W., *medical social consultant, Heart Disease Control Program.*

Nutrition and Health

Dietary habits of aged persons and their food needs were reviewed by a physician and by research and public health nutritionists. How to plan menus that meet nutritional needs was discussed and demonstrated by the use of illustrative material.

The points brought out were not new or startling. Rather, the discussion leaders cited studies and experiences which emphasized the following accepted nutrition facts.

The importance of individual variations with respect to nutrient needs, total calories, and so forth must be kept in mind always. Thus, what is a maintenance diet for Mrs. Jones may be excessive in calories for Mrs. Smith or deficient in nutrients for Miss Brown.

The aged person needs protein of high quality daily, preferably some at each meal. The National Research Council's recommended protein allowance of 65 grams daily for men aged 65 was seen by some speakers as the low limit of desirable protein intake for both men and women.

The utilization of protein is related to the total calorie intake. Studies have shown that aged women on self-selected diets were in nitrogen equilibrium only when they were consuming 1,600 to 1,800 calories a day.

Since physical activity plays an important part in the body's ability to utilize foodstuffs, aged persons should be encouraged to maintain a level of activity compatible with their physical ability.

Total calorie needs decrease for each person as his body ages. Nutrient needs (for vitamins, minerals, protein) do not seem to decline and may be increased. To maintain good nutrition without increasing body weight, the aged individual must select food with care. Regular meals probably help in attaining this objective.

Although eating a variety of foodstuffs and choosing foods from the basic seven may be the easiest way of assuring an adequate nutritive intake, diets that are fairly monotonous may still be nutritionally balanced, depending on the foods eaten, the amounts consumed, the preparation methods. A survey in one State institution bears out this point.

—DOROTHY M. YOULAND, *M.S., nutrition consultant, Chronic Disease Program, Division of Special Health Services.*

Mental Illness Among the Aging

Two meetings were devoted to mental illness in the aged. The first discussed present-day State, county, or city mental institutions, which are recognized as lacking in facilities for the proper treatment of both acute and subacute psychosis among the aged.

A professor of psychiatry advocated the establishment of psychiatric services for the aged at nursing homes and other facilities where psychiatric care could be given on a part-time or full-time basis. He also advocated the building of public institutions for the care of the aged that would provide them with appropriate psychiatric services.

The second meeting was devoted to mental illness among the aged in the family setting. It was agreed that when acute and subacute mental illness was properly treated, prognosis for the aged was as good as for young patients. It was agreed further that many mentally ill individuals could be handled best either at home full time, if given proper outpatient psychiatric treatment, or at home part time and the rest of the time in a mental institution or psychiatric hospital. Much emphasis was given to the need for part-time institutional care for many of the aged who have mental illness that is not completely incapacitating.

—SEWARD E. MILLER, M.D., *former chief, Division of Special Health Services and presently director, Institute of Industrial Health, University of Michigan.*

Reading List on Aging

Two general bibliographies on aging have been issued since 1954: Selected References on Aging; An Annotated Bibliography, 1955, and Publications on Aging; Selected Reports of Federal Agencies, 1956. The former was compiled for the Committee on Aging by the Library of the Department of Health, Education, and Welfare, and the latter by the Federal Council on Aging. These bibliographies may be obtained from the Superintendent of Documents, U. S. Government Printing Office, for 30 cents and 15 cents, respectively.

Both bibliographies are annotated and classified and include not only references to books and pamphlets but also to articles appearing in periodicals.

"Selected References on Aging" includes some 500 items compiled from current literature in the field. They are arranged within three broad interest categories: social aspects; economic and employment aspects; and the aging process, with respect to health and medical care. Other sections include reports on conferences and State commissions, conference and group discussion methods, periodicals, community helps, and personal adjustment. There is an author index.

"Publications on Aging" includes some 78 reports by or for various Government agencies. Among these items are bibliographies and exhibits, motion pictures, recordings, and scripts.

Although there is some duplication in the two bibliographies, together they afford a fairly comprehensive coverage of the literature.

The following references, not contained in these bibliographies, also may be helpful.

Brewster, A. W., and McCamman, D.: Health costs of the aged. U. S. Social Security Administration Division of Research and Statistics, Report No. 20. Washington, D. C., U. S. Government Printing Office, 1956, 126 pp. Price 65 cents.

California Legislative Assembly Interim Committee on Social Welfare: The nonpsychotic seniles and related problems. Report . . . House Resolution No. 195, 1953. Sacramento, 1955, vol. 19, No. 1, 109 pp.

Council of State Governments: The States and their older citizens. A bill of objectives and a program for action. Chicago, 1955. (Full report to the Governors' Conference priced at $3.)

Donahue, Wilma, and Tibbitts, Clark: European approaches to aging. Pub. Health Rep. 70: 581–584, June 1955.

Federal Council on Aging: Federal responsibilities in the field of aging. A statement by President Eisenhower and a summary of recent and proposed actions of the Federal Government affecting older persons. Washington, D. C., U. S. Government Printing Office, 1956 (?).

Illinois Public Aid Commission: Rehabilitation education service of the Illinois Public Aid Commission. Springfield, 1956 (?). Mimeographed.

Illinois Public Aid Commission Advisory Committee on Aging: Progress report on services for aging. Exhibit J. Springfield, 1956, 6 pp. Mimeographed.

Kaiser, Philip M.: Statement, at the Federal-State Conference on Aging. Washington, D. C., 1956, 6 pp. Mimeographed.

Mumford, Lewis: For older people—Not segregation but integration. Architect. Rec. 119: 191–194, May 1956.

Our aging population. Progress in health services (Health Information Leaflet) 5: 1–4, June 1956.

Rosenthal, P.: Second childhood, the second period of creativity. Geriatrics 10: 382–390, August 1955.

Ross, Mabel: Is there a grandparent in the house? Adult Leadership 3: 7–28, February 1955.

Sex and age differences in disability. Statist. Bull., Metrop. Life Insur. Co. 37: 1–4, May 1956.

U. S. Bureau of Old-Age and Survivors Insurance: How earnings affect social security benefit payments. OASI–23. Washington, D. C., U. S. Government Printing Office, March 1956, 15 pp. Price 5 cents ($3 per 100 copies).

U. S. Department of Health, Education, and Welfare Committee on Aging: The States and their programs in aging. A descriptive survey of the organization and activities of the official State groups on aging. Washington, D. C., 1956. Multilithed.

Symposium: Problems of the mind in later life. Geriatrics 11: 137–179, April 1956.

Federal-State Conference on Aging

Toward Improved Health for the Aging

AT THE Federal-State Conference on Aging in Washington, D. C., June 5–7, 1956, more than 250 State and Federal officials met to study the field of aging and to work toward practical programs. Following panel discussions six groups drafted recommendations with respect to Federal and State responsibilities, organization, and techniques for improving the health and welfare of the aged. The panel discussions on health and rehabilitation and the recommendations on physical and mental health are summarized here. Major recommendations of each working group were reported in the June 25, 1956, bulletin of the Social Legislation Information Service, Washington 6, D. C. Proceedings of the conference will be available from Louis H. Ravin, secretary, Federal Council on Aging, Department of Health, Education, and Welfare, Washington 25, D. C.

DISCUSSIONS

Federal-State-Local Responsibilities

The Federal Government has a vital interest in the aging problem, Dr. Lowell T. Coggeshall, special assistant for health and medical affairs to the Secretary of Health, Education, and Welfare, said in pointing to the need for public and private agencies to work together to find realistic solutions. Excellent work is being done by the voluntary agencies, and the Government should support, not supplant, such work, he said.

Coggeshall urged development of active programs of restorative services in every community to increase the functioning of the sick and disabled older person to his highest attainable level while reducing the costs of his care. Day centers and day hospitals and physical or mental therapy will tend to lessen the demand for hospital beds and bring treatment to more patients.

Research is as much a State as a Federal responsibility, Dr. Coggeshall declared. It should be carried out by the operating agencies of the State as well as by the State's medical schools. Stimulation of programs of home care, training of more practical nurses, and proper use of existing facilities will all help to reduce cost of care.

Living arrangements which permit activity, participation, and productivity will prevent a considerable degree of mental deterioration, he noted. Because almost all older people suffer periods of depression, particular care must be taken to see that these people are not committed to State hospitals during these periods. The use of intensive therapy at State hospitals has brought about a significant increase in the discharge rate. Such treatment has a higher cost per day, but its total cost is much less since the patient remains in the hospital a relatively shorter time.

Coggeshall listed four responsibilities of the official health agency: public education, stimulation or provision of services, training of adequate numbers of health personnel, and research.

The Administration's philosophy, he said, is that maximum freedom must be guaranteed to our senior citizens. The emphasis is on encouraging individual initiative within our free society, and thus enriching life for every individual.

The aging problem is primarily a community responsibility, according to Dr. Henry Mulholland, chairman, Committee on Aging, American Medical Association. He emphasized the need for careful community planning

and for coordination of various agencies and facilities. He noted that, while such institutions as nursing homes, homes for the aged, and rehabilitation centers are all necessary, "they should not make us forget that the home itself is often where the older person is happiest, when it is possible for him to remain there."

Neglected Health Problems

Dr. Lester Breslow, chief, bureau of chronic disease, California Department of Health, said that all too frequently aged patients in institutions are there not because of their disease but because of neglect of the disease. With modern methods, persons suffering a stroke need not remain bedridden the rest of their lives.

Dr. Breslow mentioned the need for good nutrition in later years and said that such everyday necessities as eyeglasses, hearing aids, and dental care should not be overlooked. Early detection through multiphasic screening can often help prevent or delay diabetes, glaucoma, and cancer. He emphasized that "we should make sure that the money we spend for our older population is wisely spent, not for more drugs and more beds—mere custodial care—but for the newer diagnostic, rehabilitative, and other services which will truly advance the health of the aging."

Degenerative disease is now an obsolete term, Breslow said. Even arteriosclerosis and cancer can be helped, and we now believe these may be due to specific environmental factors rather than to inborn, constitutional causes.

In one study of nutrition in persons from 50 to 80 years of age, it was found that many were not getting vitamin C and other nutrients necessary to a well-balanced diet. A health and health services survey in Santa Cruz County highlighted need for eyeglasses, hearing aids, and dental care among the aged. One California county health officer organized a health checkup for every recipient as he was accepted for assistance, with a view to correcting or alleviating conditions needing attention. The public welfare budgets in most counties do not provide enough money to maintain adequate health standards for recipients.

Rehabilitation Services

"Restorative medicine," a term describing measures taken to improve the functions of people with disabilities resulting from illness that comes with aging, was discussed by Dr. Michael Dacso, director of geriatric rehabilitation, Goldwater Memorial Hospital. We must rehabilitate people to self-care without regard to their vocational goals, he said. We can expect higher dividends by investing more at the beginning through skilled workers and excellent services. How to get the young medical man acquainted with and interested in the problems of the aged and the chronically ill is a question we must answer.

Few rehabilitation services are available to the aged who are disabled, according to Dacso. The tendency is to do the most for the reemployable. Probably 70 to 80 percent of all the disabled could be cared for at home with proper medical direction and auxiliary help.

We should practice "anticipatory medicine" (Stieglitz' term); that is, we should anticipate complications which may arise with a particular illness and take steps to prevent such complications. Rehabilitation services are expensive, but economy measures in rehabilitation frequently turn out to be more expensive in the end. People who could have been directed toward partial or complete self-help at the beginning of their trouble are robbed of that opportunity as they lose more of their health or their initiative and self-reliance.

Common, garden-type depression or melancholia is the type of mental illness most frequently encountered among older persons. Metabolic disorders and senile dementia are other common troubles. But even many afflicted with senile dementia could be returned to their homes. A fact we must face is that many families do not want their aged members back after they have had institutional care. Probably between 60 and 70 percent of old people in mental hospitals could be returned to their homes, although not necessarily as self-supporting citizens.

Today the medical pendulum is swinging back from hospital care to home care, Dr. Jack Ewalt, Massachusetts commissioner of mental health, observed. He stressed the need for careful research on all phases of aging and de-

plored the use of such thoughtless generalizations as "all old people should retire" or "all old people should keep on working."

Cost of Care

E. A. Van Steenwyk, director of the Philadelphia Blue Cross, gave examples of the mounting costs of hospital care and explained the expense of carrying older persons on the insurance rolls. He added, however, that companies must continue coverage on policyholders as they grow older. Blue Cross continues to cover policyholders who are retired or aged or both, he pointed out, but no insurance firm can do this unless it has had subscribers long enough to build up a funding system big enough to cover the expense of the aged.

More use of public health nursing services could be made and would pay off. It is far more economical to keep the moderately ill or the chronically ill patient at home than to put him in a $25- to $30-a-day hospital bed, Van Steenwyk noted. He urged closer coordination of the various agencies concerned with the aging problem and "wise spending" of all money appropriated toward this end.

RECOMMENDATIONS

The working group on physical and mental health emphasized the need to intensify community education to increase understanding of the problems of the aged and to make known what facilities and services are available. The group agreed that each individual must do his best to maintain his own and his family's health. With the objective of helping people to help themselves, they made the following recommendations:

Maintenance and promotion of health. Health and health-related agencies and groups should take constructive action to maintain and promote the health of all persons through programs for early detection of disease, prevention of disease and its consequences, suitable care during illness, and restoration of physical and mental health. All facilities for the care of the aged, including foster care homes, nursing homes, specialized housing, hospitals, and rehabilitation centers, should be of high quality. They should provide for careful medical appraisal and social evaluation of each individual.

Treatment of the whole person. State and community agencies should fully accept the concept of treatment of the whole person, as opposed to a focus on a particular disease entity. Analysis of the health and welfare characteristics of the community should serve as the basis for coordinated services to lessen the effects of disease and to reduce stay in hospitals and institutions.

Homelike conditions. Institutions and hospitals should not be regarded as the normal habitat of human beings. It is deemed of great benefit to the individual, the family, and the community to keep individuals in their own homes. If this is not possible, care should be provided in a situation approaching home conditions as closely as possible.

Participation in community life. States and communities are urged to encourage aging persons to participate in all phases of personal and community life. For example, financial incentives should be used to encourage nursing homes to keep patients mobile and to make full use of community services.

Community services. Community services for the aged should be provided to fill the needs of the individual fully but economically. Services should include homemaking aids, public health nursing, nursing homes, hospitals, case-finding activities, and rehabilitation. Transition of the patient between the simple, more economical services and the complex, more expensive ones must be easy.

Commitments to mental hospitals. Because of lack of suitable facilities at the local level for care of older persons, many are being needlessly committed to State mental hospitals. Medical care at the local level that includes screening, diagnosis, and early treatment can prevent many unnecessary commitments and certain other psychiatric casualties.

Nursing homes. To improve the quality and quantity of medical and nursing care in nursing homes, general hospitals and nursing homes are urged to work together in developing effective working relationships. Wherever possible, nursing homes should be administratively affiliated with general hospitals.

Food and drug protection. Official agencies should extend research, evaluation, and regulations concerning special foods, drugs, cosmetics, and various devices which are especially appealing to aging persons and which may be harmful to them.

Research and demonstrations. Federal, State, and private agencies should provide grant-in-aid funds for demonstrations of community health services for the aged and for both basic and applied research in gerontology.

Teaching of basic concepts. Funds should be provided to develop programs in universities for teaching students in health and related fields the basic concepts essential to the care and understanding of the aged. The need for focusing attention on the problems of the health of the aged can best be met by the appointment of a coordinator.

Alleviation of personnel shortages. To alleviate acute shortages of trained personnel in health, hospital, and related facilities, it is recommended that refresher training programs be expanded or initiated to develop community personnel resources; that action be taken to expand and improve acceptable professional training schools and facilities; that the possibilities of short courses for training personnel to aid professional staff be studied; and that recruitment programs be stepped up to permit maximum use of all existing and future training facilities and services.

Coordinating and advisory groups. Each State and each community should develop an effective, broadly representative organization to study and make known the problems and needs of the aging population and to suggest, support, and coordinate suitable and meaningful activities within existing agencies to meet these needs. All official health, welfare, rehabilitation, education, and recreation agencies should be represented in this organization. In addition, there should be a citizens advisory group to provide liaison between this organization and the general population. This group should include representatives from interested professional societies and voluntary agencies.

Retirement. Retirement based on attainment of a certain chronological age results in some employees remaining on the job beyond the time when they are productive while others are retired who still have years of productive life ahead. Government and industry should be encouraged to expand and extend their health evaluation programs with the objective of determining more accurately the proper time for retiring individual employees.

Health insurance. Health insurance and other programs for financing medical care should permit flexibility in the use of treatment facilities and should facilitate transfer of patients among hospitals, nursing homes, and their own homes. Extension of voluntary health insurance coverage to the aged and arrangements for continuing health insurance after retirement, with benefits adapted to the increased health needs of older persons, should be encouraged. The utilization of health insurance plans should be considered in providing medical and hospital care to the aged public assistance recipient.

The chairman of the working group on physical and mental health was Dr. S. D. Pomrinse, chief, Health of the Aged, Division of Special Health Services, Public Health Service. Dr. C. J. Ruilmann, Tennessee commissioner of mental health, and Steven Horvath, professor of physiology and acting director of the Institute of Gerontology, State University of Iowa, were group leaders.

Rural Health Survey of Men Over Forty

By JOHN PEMBERTON, M.D., and KENNETH I. E. MACLEOD, M.D., M.P.H.

APPLICATION of preventive medicine to the later years of life is gaining attention from public health agencies. This is partly due to the remarkable decline in the mortality of children and young adults, which has brought the problems of morbidity and mortality in middle life into prominence, and partly to the failure of therapy in preventing the alarming rise in the death rates from certain diseases, such as coronary thrombosis and cancer of the lung, which bear most heavily on men in middle and later life.

A survey in 1955 was designed to find out something about the state of health, especially of the heart and lungs, of a group of men over the age of 40 who were living in a rural community. The study population, living or working in 6 of 16 towns of the Nashoba Health District in Massachusetts, was composed of all the men in the chosen age group who wished to be examined.

Altogether, 642 men came for examination. From many occupational classes, they included physicians, bankers, priests, farmers, school teachers, clerks, and industrial workers of various grades of skill. The factories in which these men worked were small, long-established concerns situated in rural townships ranging from 500 to 4,000 in population. The plants included a tannery, two paper mills, a cordage factory, a cutlery works, and a plant manufacturing elastic underwear.

The participation rate from the factories was high. From information about the number in the eligible age group in two factories, where this point was checked, it was found that 47 out of 54 had come from one factory and 50 out of 52 from the other. There is, therefore, reason to believe that the sample was representative. Of course, those who were unable to come because of sickness or disability were necessarily excluded.

Participation was encouraged by vigorous preliminary publicity organized by a women's committee, utilizing press and radio, and the response was almost overwhelming.

The survey lasted for 3 weeks. In addition to daily sessions, several evenings were devoted to examinations for the convenience of the industrial workers.

Examination Procedures

A public health nurse recorded each patient's history of past illnesses, occupation, residence, and habits of tobacco smoking. The subject was weighed in indoor clothes and his height measured with his shoes on. Subsequently, 3 pounds was subtracted from the weight and three-fourths of an inch from the height.

Dr. Pemberton is a senior lecturer in social and industrial medicine in the University of Sheffield, England. From 1954 to 1955 he was a Rockefeller traveling fellow in medicine. Dr. Macleod is commissioner of public health in Worcester, Mass., and instructor in public health practice in the Harvard School of Public Health. He was formerly medical director for the Nashoba Associated Boards of Health, Ayer, Mass.

The assistance of the American Cancer Society made the survey possible.

A full-sized standard chest X-ray was taken. The Massachusetts Department of Public Health provided the chest X-ray machine and radiographers, and Dr. Marrian W. Perry of the State health department read the films. Helping organize the project were members of the Nashoba Health District Chest Survey Committee.

After the films were taken, each man was examined by one of the physicians with special reference to pulmonary disease. This examination included a respiratory function test, the 1-second timed vital capacity, to help detect emphysema (*1*). This test measures the vital capacity and also the proportion of the vital capacity which can be expired during the first second of a forcible expiration following a maximum inspiration. Finally, the subject was examined by the other physician with special attention to the cardiac system. This examination included measurement of the blood pressure with the subject in a sitting posture after a 5-minute rest. Whenever an abnormality requiring treatment was discovered, the subject was advised to see his private physician, to whom a report was sent.

The record sheets were designed to facilitate statistical analysis. The data were coded, transcribed, and punched on cards. Of the 642 records, 42 were incomplete, usually because the subject had failed to enter one examination room in his tour and had not been missed until after he had gone home. Thus, 600 completed records were available for analysis.

In selecting the data for presentation, we have confined ourselves mainly to those conditions which were common, and we examined their prevalence in relation to certain identifiable characteristics such as age, weight, occupational class, and smoking habits.

Table 1. Number and percent of study group, by age, Nashoba Health District, Massachusetts

Age	Number	Percent
35–39	5	0.8
40–44	157	26.2
45–49	114	19.0
50–54	96	16.0
55–59	82	13.6
60–64	68	11.3
65–69	40	6.7
70–74	22	3.7
75–79	10	1.7
80–84	3	.5
85–89	3	.5
Total	600	100.0

Table 2. Number and percent of study group, by occupational class

Occupational classifications	Number	Percent
I. Unskilled labor	56	9.3
II. Semiskilled labor	196	32.7
III. Skilled labor	135	22.5
IV. Clerical	20	3.3
V. Retail proprietors, school teachers, and administrators	130	21.7
VI. Higher income professions	32	5.3
VII. Retired	30	5.0
Not recorded	1	.2
Total	600	100.0

General Characteristics

A wide range of ages were represented, but the sample consisted mainly of the middle-aged (table 1). About 85 percent were between the ages of 40 and 65. Five men were under the age selected for study.

There were no nonwhite men in the sample. Eighty-five percent were born in the United States, 6 percent in Canada, and 9 percent in Europe.

Six occupational classes were represented, with semiskilled and skilled workers predominating. Only 5 percent of the men had retired (table 2).

The great majority of the sample had always, or nearly always, lived in rural neighborhoods: 79.2 percent had spent less than one-tenth of their lives in cities of 100,000 population or more.

Tobacco Smoking

Table 3 shows the smoking habits of the sample for two age groups and for all ages. Of the lot, 28.8 percent were either nonsmokers or ex-smokers. Heavy cigarette smokers, defined as those smoking 20 or more cigarettes a day, were 38.3 percent of the total. The older men smoked less than the younger. A higher pro-

portion of those aged 55 or over had never smoked or had given up smoking, and the percentage of heavy cigarette smokers in the older group was only half that in the younger group. More older than younger men limited their smoking to a pipe or cigars.

The 89 ex-smokers were asked when they had abandoned the habit and for what reasons. There was evidence that the rate of giving up smoking had increased in recent years. More than a third of the ex-smokers had given up the habit during the 4 years immediately preceding the survey. Of the 55 who gave a reason for quitting, 18 said they did so to try to get rid of a cough, 10 stopped on medical advice, 2 quit after a surgical operation, and 24 gave nonmedical reasons. Only one asserted that he stopped smoking because of publicity on cancer of the lung.

Pulmonary Conditions

There were 13 cases of pulmonary tuberculosis suspected on the basis of the full-sized chest films. Of these, only one was ultimately found to be active. Three were of doubtful activity.

Chest radiography disclosed two suspected cases of neoplasm. One man was found to have a benign tumor of the lungs, which was successfully excised. The other, at the time of writing, had failed to consult his physician.

The prevalence of chronic nontuberculous pulmonary disease in the different age groups appears in table 4. The definitions of the diseases listed and a description of the diagnostic methods are published elsewhere (*2*).

Approximately three-fourths of each age group had no detectable pulmonary condition. Primary asthma was ascribed if there was a history of typical asthmatic attacks starting before the age of 25. This condition was not rare and was fairly evenly distributed in the age groups studied. The last three groups in the table represent increasing degrees of severity of chronic respiratory disease which, when fully developed, may be called chronic bronchitis, emphysema, and bronchial spasm. In its fully developed form it was uncommon under the age of 65.

Smokers' cough was the term applied to cough symptoms in those men who were heavy smokers if the answer to the first of the following questions or to any four of the others was "yes" and if no other cause for the cough was found:

Does the cough go if you give up smoking?
Does the cough get less if you give up smoking?
Do you think the cough is due to smoking?
Is it a dry cough?
Is the cough the same in the winter and the summer?
Is it largely confined to the first hour after rising?
Is the cough largely associated with the first cigarette?

The prevalence of smokers' cough diminished with advancing age. This may be related to the smaller proportion of heavy cigarette smokers in the older age groups (table 3).

Table 3. Tobacco smoking habits in study group, by age

Age	Total	Never smoked		Ex-smokers		Cigarettes per day										Pipe or cigar only or both		Unrecorded	
						5 or less		About 10		About 20		About 30		40 or more					
		Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total	600	84	14. 0	89	14. 8	50	8. 3	53	8. 8	162	27. 0	42	7. 0	26	4. 3	91	15. 2	3	0. 5
35–54	372	47	12. 6	44	11. 8	32	8. 6	29	7. 8	120	32. 3	33	8. 9	21	5. 6	44	11. 8	2	. 5
55–89	228	37	16. 2	45	19. 8	18	7. 9	24	10. 5	42	18. 4	9	3. 9	5	2. 2	47	20. 6	1	. 4

The relationship between cigarette smoking and chronic respiratory disease, excluding the 72 men with smokers' cough, appears in table 5. The frequency of chronic nontuberculous respiratory disease increased consistently through the various grades of smoking, from 4.8 percent in the nonsmokers to 29.4 percent in the heavy cigarette smokers. (The X^2 test showed that this association of chronic nontuberculous respiratory disease with tobacco smoking was highly significant, $P>0.001$).

Respiratory Function

There was an interesting association between tobacco smoking and respiratory function as measured by the timed vital capacity test (table 6).

The incidence of abnormally low vital capacity was considerably lower in the lifelong nonsmokers than in the other groups. The differences, however, did not quite reach the conventional 5 percent level of statistical significance. To measure the relationship between the vital capacity measurements and tobacco smoking history, the man's vital capacity was expressed as a percentage of the value predicted for him by use of the formula of Baldwin, Cournand, and Richards (*3*). More of the smokers had abnormally low vital capacities than the nonsmokers or ex-smokers; but, again, the differences were not statistically significant.

It was found that 51 out of 233 heavy cigarette smokers gave a history of wheezing (21.9 percent) compared with 12 out of 171 nonsmokers or ex-smokers (7.0 percent). The

Table 4. Chronic nontuberculous pulmonary disease in study group, by age

Condition	Age								Total	
	35–44		45–54		55–64		65 and over			
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Normal	118	72.8	155	73.8	104	69.3	56	71.8	433	72.2
Smokers' cough	25	15.4	29	13.8	15	10.0	3	3.8	72	12.0
Primary asthma	4	2.5	4	1.9	3	2.0	2	2.6	13	2.1
Emphysema or bronchial spasm alone or together	4	2.5	7	3.3	11	7.4	3	3.8	25	4.2
Chronic bronchitis alone or with emphysema or bronchial spasm	8	4.9	14	6.7	12	8.0	5	6.4	39	6.5
Chronic bronchitis with emphysema and bronchial spasm	3	1.9	1	.5	5	3.3	9	11.6	18	3.0
Total	162	100.0	210	100.0	150	100.0	78	100.0	600	100.0

Table 5. Tobacco smoking and chronic nontuberculous respiratory disease, excluding smokers' cough, in study group

Condition	Nonsmokers		Ex-smokers		Pipe or cigar only or both		Cigarettes per day				Total	
							Less than 20		More than 20			
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Normal	80	95.2	80	89.9	76	86.4	77	79.4	120	70.6	433	82.0
Chronic nontuberculous respiratory disease	4	4.8	9	10.1	12	13.6	20	20.6	50	29.4	95	18.0
Total	84	100.0	89	100.0	88	100.0	97	100.0	170	100.0	528	100.0

difference between these percentages was statistically highly significant.

The occupational and residential histories failed to reveal that more than a few had ever been exposed to harmful dust in their work or to air polluted by urban industry. It is assumed, therefore, that these factors had no significant part in the etiology of chronic respiratory ailments.

Cardiac Conditions

Twenty-three of the men were under the care of a private physician because of known heart disease, usually coronary artery disease. An additional 10 reported that they had had a previous coronary thrombosis from which they had recovered. These 33 cases represented only the gross manifestations of cardiac disease. There were probably additional patients whose symptoms had not caused them to consult a physician.

Special questions were introduced soon after the start of the survey to detect the presence of angina pectoris. Altogether, 42 of 407 questioned (10.3 percent) gave a typical history of pectoral angina precipitated by effort.

The percentage of heavy cigarette smokers (20 or more a day) among those with angina pectoris was 40.5 percent, nearly the same as the percentage among those without angina, 41.6.

There was no significant difference in the distribution by occupational class among those with angina pectoris and those without. There was a significantly higher proportion with enlargement of the heart (diagnosed by the chest roentgenogram) in the subjects with angina pectoris than in those without. And a greater proportion of those with angina pectoris had systolic blood pressures of 160 mm./Hg or more and diastolic blood pressures of 100 mm./Hg or more than in those without. The differences in this case, however, did not reach the conventional level of statistical significance.

Overweight

Overweight was assessed by reference to average values of weight for given ages and heights, based on recent tables of mean weights at different heights and ages (*4*). All those who, at a given height and age, exceeded the mean weight by 10 percent or more were termed overweight. This group was further subdivided into those who were 10–19 percent overweight and those who were 20 percent or more overweight (table 7). Of the 600 subjects, 24 percent were overweight. More than 1 out of 10 exceeded by 20 percent or more the mean weight for age and height. The highest prevalence of overweight was found in the years 55–64. The apparent fall after this age may be attributed to a tendency for people to lose weight after the age of 64 or to higher mortality rates among those who are overweight. The association of certain signs of ill health with overweight was scrutinized.

Systolic and diastolic hypertension, pitting edema of the ankles, and a low vital capacity were more common among the overweight persons than among those of normal weight. The differences in these rates, however, did not reach the conventional level of statistical significance. Angina pectoris was equally common in those

Table 6. Tobacco smoking and the 1-second timed vital capacity in study group

Timed vital capacity	Nonsmokers		Ex-smokers		Pipe or cigar only		Cigarettes per day				Total	
							Less than 20		More than 20			
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Abnormally low (less than 65 percent)	3	3.6	8	9.0	8	8.8	9	8.7	30	12.9	58	9.7
Normal (65 percent +)	81	96.4	81	91.0	83	91.2	94	91.3	203	87.1	542	90.3
Total	84	100.0	89	100.0	91	100.0	103	100.0	233	100.0	600	100.0

who were overweight and in the remainder. There was no association between overweight and occupational classification. The percentage of overweight persons in classes I and II combined was 23.8; in class III, 25.3; and in classes V and VI, 25.3. There was a slightly lower percentage of overweight subjects among the heavy smokers.

High Blood Pressure

High blood pressure is often regarded as inimical to a long and healthy life, although surveys of this type usually disclose a considerable number of symptomless individuals with high blood pressure readings, who appear to be in robust health and may indeed be of advanced age. Table 8 shows the distribution of systolic and diastolic pressures by age. The proportion with high systolic pressures (160 mm./Hg or over) increased steadily with advancing age. The proportion with diastolic blood pressures of 100 mm./Hg or more increased with advancing age until age 64 and then leveled off.

The analysis revealed no relationship between

Table 7. Number and percent overweight in study, by age

Overweight group	Age								Total	
	35–44		45–54		55–64		65+		Number	Percent
	Number	Percent	Number	Percent	Number	Percent	Number	Percent		
10–19 percent above average weight for height and age	22	13.6	27	12.9	26	17.3	4	5.1	79	13.2
20 percent or more above average weight for height and age	15	9.3	15	7.1	22	14.7	13	16.7	65	10.8
Total overweight	37	22.8	42	20.0	48	32.0	17	21.8	144	24.0
Total normal weight	125	77.1	168	80.0	102	68.0	61	78.2	456	76.0
Total all weights	162	100.0	210	100.0	150	100.0	78	100.0	600	100.0

Table 8. Systolic and diastolic blood pressure in study group, by age

Blood pressure (mm./Hg)	Age								Total	
	35–44		45–54		55–64		65+			
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Systolic										
80–159	154	95.0	180	85.7	104	69.3	47	60.3	485	80.8
160–179	5	3.1	18	8.6	25	16.7	14	17.9	62	10.3
180–249	3	1.9	9	4.3	20	13.3	17	21.8	49	8.2
Unrecorded	0	.0	3	1.4	1	.7	0	.0	4	.7
Total	162	100.0	210	100.0	150	100.0	78	100.0	600	100.0
Diastolic										
0–99	148	91.4	177	84.3	116	77.3	62	79.5	503	83.8
100–119	13	8.0	26	12.4	25	16.7	11	14.1	75	12.5
120–149	1	.6	4	1.9	8	5.3	5	6.4	18	3.0
Unrecorded	0	.0	3	1.4	1	.7	0	.0	4	.7
Total	162	100.0	210	100.0	150	100.0	78	100.0	600	100.0

high systolic or diastolic blood pressure and occupational class or between high blood pressure and heavy cigarette smoking.

Discussion

The survey was limited in scope. Its major emphasis was on the discovery of chronic pulmonary and cardiac disease in a sample of men residing in a rural area. They were not chronically exposed to the crowding and air of cities. They seemed reasonably prosperous, and, in the six factories we visited, the conditions of work appeared healthful.

On the whole, their health was favorable. There was little significant pulmonary tuberculosis. There were those with frank cardiac disease, as would be expected at these ages, and no doubt a further number with incipient cardiovascular conditions.

Chronic cough, if smokers' cough is included under this heading, was common. An attempt was made to distinguish chronic bronchitis cases in the group with coughs. When this was done, it appeared that approximately 10 percent of the whole sample had chronic bronchitis. In only 3 percent of the sample, however, did we find the fully developed syndrome of chronic bronchitis, emphysema, and bronchial spasm. Half of the 18 severe cases occurred in men over 65. Before this age, it was rare. The prevalence rate of chronic nontuberculous respiratory disease (excluding smokers' cough) was significantly and directly correlated with tobacco smoking. The relatively large proportion of smokers and ex-smokers with abnormally low 1-second timed vital capacities compared with lifelong nonsmokers suggests a relationship between tobacco smoking and pulmonary function. Whitfield, Arnott, and Waterhouse (*5*) found evidence that tobacco smoking reduces the vital capacity and increases the ratio of residual air to total lung volume, and both Palmer (*6*) and Oswald and Medvei (*7*), in studies of large unselected population groups, found a direct relationship between the amount of cigarette smoking and the prevalence of chronic bronchitis.

The other most striking finding in this survey was the high prevalence of overweight. Life insurance statistics have shown that overweight policyholders are more likely than those of normal weight to die of diabetes, diseases of the biliary tract, appendicitis, nephritis, cerebral hemorrhage, cirrhosis of the liver, heart disease, hernia, and intestinal obstruction (*8*). Among the overweight in this sample, there were higher prevalence rates of high blood pressure, pitting edema of the ankles, and low vital capacities, and there were fewer heavy cigarette smokers. None of these differences, however, reached the conventional level of statistical significance. There was no relationship between overweight and occupational class or between overweight and angina pectoris. Keys (*9*) has reported a similar lack of association between overweight and coronary artery disease.

The small sample we examined failed to show any significant impairment of health that might be attributed to a deficiency in diet, shelter, or working environment. On the other hand, it is possible that the heart, respiratory, and overweight conditions observed may be attributed in part to a contemporary mode of living. Relative affluence, associated with full employment at attractive wages, permits diets abounding in fats and of as many cigarettes as time permits. The ubiquitous automobile and other forms of power machinery materially reduce the need to burn fats by physical exertion. It may be suspected then that a mode of living no less than aging contributes to certain afflictions characteristic of middle and later life. Identification of such immediate, as well as earlier, sources of impairment to health is a new task for preventive medicine.

Summary

Among 600 middle-aged and elderly men living in a rural area of Massachusetts, chronic cough, including "smokers' cough," was found to be common. Excluding cases of smokers' cough, there was a direct and significant relationship between tobacco consumption and the prevalence of nontuberculous chronic respiratory disease.

Only one case of active pulmonary tuberculosis was discovered.

Heart disease was not uncommon, and 3.6 percent were seeing a physician for this condition.

There were in addition, 10 men who had recovered from a previous coronary thrombosis.

Overweight was common; 13 percent were 10–19 percent above their expected weight for height and age, and a further 11 percent were 20 percent or more overweight.

It is concluded that conditions of prosperity may favor the development of certain diseases as want did in the past and that a study of this relationship constitutes an important field for preventive medicine.

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Center for Aging Research

In recognition of the urgent need to solve the special health problems of an aging population—the number of citizens over age 65 is expected to surpass 18 million by 1970—the Public Health Service on October 30 created a Center for Aging Research in the National Institutes of Health.

The center will coordinate research activities in the institutes and will stimulate additional research into the mechanisms involved in aging. Dr. G. Halsey Hunt, former associate chief of the Bureau of Medical Services has been named to direct its activities.

The new center is part of the Public Health Service's accelerated activities in the field of aging. Dr. John W. Porterfield, Assistant Surgeon General, will direct and coordinate all of the Service's activities in this field.

The Public Health Service has long been concerned with the health problems of the aging. In State and local health departments, restorative services for the aged are being supported in part by the Bureau of State Services. The major research effort of the Service has been centered in the National Institutes of Health, which at present is expending about $2 million in its own research activities and in grant support of projects directly related to aging.

The accelerated programs will encourage and support research institutions in bringing the full range of biological, phychological, and social sciences to bear on the problem of aging. Part of the support to be provided by the Service will be in the form of research grants that will assist universities, medical schools, and other research institutions in establishing research centers on aging.

Blindness Among the Aged

By NEDRA B. BELLOC, M.A.

VISUAL ACUITY may be likened to a spectrum, ranging from normal or perfect vision at one end to total blindness or absence of light perception at the other. In a discussion of the extent of "blindness" in the aged population, it is necessary to remember that we are dealing with an arbitrarily defined group that includes only those with severe visual loss. The most widely accepted definition of "economic blindness" is that used in the administration of many programs of aid to the blind. Under this definition a person is blind if the vision of the better eye with best possible correction is 20/200 or less, or if he has a field defect in which the widest diameter of the visual field subtends an angular distance no greater than 20°. Persons in this group and many others with less loss of vision bear an inestimable burden in the social and occupational adjustments which their handicap requires of them.

How many aged persons are blind? How long have they been blind? What caused their blindness? These and other questions confronted the California State Department of Public Health when, in 1954, it received a grant from the W. K. Kellogg Foundation for a project in the prevention of blindness.

The Prevalence of Blindness

The literature reveals that most surveys of blind persons have been limited to recipients of aid from one of the programs for the needy blind (*1–9*). Notable exceptions are New York and North Carolina, which have registers of blind persons (*10–11*).

The most widely used estimates of the prevalence of blindness are those of Hurlin (*12*) and are based on the assumptions that the rates will vary with age and race composition and with the public health standards of the States.

Data on the incidence of blindness are almost entirely lacking and, except where registers exist, must be inferred from prevalence figures (*13*).

During the year May 1954–April 1955, the California State Department of Public Health conducted a survey of a sample of about 10,000 households throughout the State. Data collected included population characteristics, illnesses, accidents, chronic conditions, and receipt of medical care. Interviewers handed respondents a list of chronic conditions which included blindness and asked, "Has anyone in the family had any of these conditions during the past 12 months?" The interviewers then read each condition aloud and paused for the respondent's reply.

Responses which indicated losses of vision more severe than those due to refractive errors were later coded as blindness, partial blindness, or vision impairment. The coding was done with the aim of producing an underestimate of blindness. Admittedly, some persons who were classified as blind may have better than 20/200 vision, but it is also likely that a larger number of those who were classified as partially blind are actually blind by the usual definition. It was apparent from the terminology of the responses, and from the comparisons which could

Mrs. Belloc is associate statistician with the prevention of blindness project, bureau of chronic diseases, California State Department of Public Health.

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be made with available medical records, that to most lay people blindness means absence of light perception.

The prevalence rates shown in table 1 for the population 65 years of age or over are probably conservative estimates of the extent of vision problems.

Because of the size of the sample (2,600 persons aged 65 and over), these rates are subject to rather large sampling errors, and differences between income groups are not statistically significant. (The sampling error for the rate of 1.4 is ± 0.2.)

In North Carolina, which has kept a careful register of blind persons for some years, 2.25 percent of the population aged 65 and over was blind according to the most recent report (*11*).

Another approach to the problem of determining the prevalence of blindness among the aged is to examine the portion of the population that receives public assistance. In California, recipients of aid to the blind normally receive $10 more per month than they would receive under the old age assistance program. This differential probably encourages qualified persons to apply for aid to the blind rather than for old age assistance. It is known, however, that some blind persons are receiving old age assistance.

In California in December 1954, 271,347 persons were receiving old age security (*14*), and 8,025 persons aged 65 or older were receiving aid to the blind. Thus, 2.9 percent of the indigent aged were receiving the pension for the blind. In counties known to have a liberal policy regarding applications for aid to the blind, this percentage was slightly higher. A blindness rate of approximately 3 percent in the indigent aged is not inconsistent with the rate of 2 percent shown for the aged population with incomes under $2,000 per year in the California Health Survey. One would expect the highest blindness rate to be in the indigent population since blindness so often leads to dependency.

Obviously, then, blindness, with a prevalence rate of between 1.5 and 3.0 percent of the aged population, does not concern as many people as arthritis or arteriosclerotic heart disease. However, its prevalence is about the same as diabetes or neuritis in this segment of the population, according to data gathered by the California Health Survey, and its impact on those affected is undoubtedly greater.

In surveying the possible sources of data in California, the project found that the largest single group of records on blind adults is available in the California State Department of Social Welfare, which, together with the county welfare departments, administers aid to more than 12,000 needy and partially self-supporting blind persons. No analysis had been made of these records since 1945 when the department of social welfare published a study based on the 1941 caseload (*4*). In December 1954 the project surveyed the causes of blindness in this group, using as a source the reports of eye examinations made by physicians. Almost two-thirds of the recipients were 65 years of age or over. The study included 1,605 persons in this age group, representing a 20 percent sample of those who were 65 years of age or over.

Persons receiving aid to the blind may not be representative of all the blind since some causes may occur more frequently among those in higher economic groups, but data on the self-sufficient portion of the blind population are not available.

Table 1. Prevalence rates of blindness, partial blindness, and impaired vision [1] among 2,600 persons, 65 years of age or over, by family income group, California Health Survey, 1954–55

Family income group	Percent		
	Blind	Partially blind	Vision impaired
All groups	1.4	0.9	2.4
$5,000 and over	1.5	1.9	1.1
$2,000–$4,999	.8	.4	2.8
Under $2,000	2.0	.8	2.8

[1] Excludes correctible refractive errors and all unilateral conditions.

Age at Onset

Blindness had its onset before the age of 25 years for only about 6 percent of the group, and for an additional 5 percent it began between 25 and 44 (table 2). For about one-third the

Table 2. Age at onset of impaired vision for 1,605 recipients of aid to the blind, 65 years of age or older,[1] California, December 1954

Age at onset (in years)	Total		Present age (percent)				
	Number [1]	Percent	65–69	70–74	75–79	80–84	85 and over
Total	1,605	100	100	100	100	100	100
Under 1	18	1.1	2.2	2.0	1.5	----	0.3
1–4	12	.8	2.2	.3	1.2	.3	----
5–14	40	2.5	4.0	3.4	3.4	1.8	.5
15–24	29	1.8	3.2	3.1	1.8	.6	.8
25–44	85	5.3	12.3	6.1	4.3	3.9	1.6
45–64	493	30.7	64.2	47.4	30.9	14.2	7.4
65 and over	867	54.0	6.5	33.4	54.7	74.7	86.2
Unknown	61	3.8	5.4	4.1	2.1	4.5	3.2

[1] A 20 percent sample of those receiving aid in December 1954.

SOURCE: Eye examination reports of the division for the blind in the California State Department of Social Welfare.

trouble began in late middle life, and for more than half (54 percent) the condition started after the age of 65. The onset of blindness represents a different problem in each of these age groups, and its prevention will therefore have a different meaning. For those blinded in childhood or youth, the problem is one of training for a self-sufficient and productive life in a sighted world. Preventive activities here save society the expense of either this additional training or of supporting a dependent person for his lifetime. For those blinded in the early years of maturity, the problem is one of readjustment and rehabilitation, again with costly periods of training and possible dependency. Blindness which occurs after the period when occupational rehabilitation is feasible is likely to result in dependency, and its prevention means, of course, a prolonging of the productive years.

The Causes of Blindness

Tables 3 and 4 relate to the causes of blindness among this group of aged persons. Cataracts acounted for 35 percent of the blindness and glaucoma for another 16 percent. A large proportion of these cases are preventable or treatable. Next in importance were arteriosclerotic disease of the choroid and retina, with 11.3 percent, and retinal degeneration, with 7.5 percent (table 3).

General (systemic) diseases accounted for

Table 3. Primary pathology of blindness [1] for 1,542 recipients of aid to the blind, 65 years of age or older, California, December 1954

Pathology	Number	Percent
Total [2]	1,542	100.0
Glaucoma	246	16.0
Refractive errors	69	4.5
Structural anomalies	7	.4
Degenerative changes	16	1.0
Cornea:		
Keratitis	46	3.0
Pannus	30	1.9
Ulceration and vascularization	3	.2
Other affections of cornea	19	1.2
Iris:		
Iritis	1	.1
Iridocyclitis and uveitis	18	1.2
Other affections of iris	4	.3
Lens:		
Cataract	538	34.9
Other affections of lens	4	.3
Choroid and retina:		
Choroiditis	2	.1
Retinitis	56	3.6
Chorioretinitis	77	5.0
Detached retina	5	.3
Retinal degeneration	116	7.5
Arteriosclerotic disease of choroid and retina	175	11.3
Other affections of choroid and retina	2	.1
Optic nerve atrophy	86	5.6
Other	22	1.4

[1] Last eye to go blind. When age at onset was the same in both eyes, but different pathologies were given, pathology for the right eye was used.

[2] A 20 percent sample of those receiving aid. Excludes 63 cases for which a report of pathology was not available.

SOURCE: Eye examination reports of the division of the blind in the California State Department of Social Welfare.

Table 4. Etiology of blindness [1] for 1,542 recipients of aid to the blind, 65 years of age or older, by sex, California, December 1954

Etiology	Males	Females
Total number [2]	674	868
Total percent	100.0	100.0
Infectious diseases	5.6	6.2
Syphilis	2.8	1.6
Ophthalmia neonatorum	-------	.1
Trachoma	2.2	2.6
Tuberculosis	.1	.2
Meningitis	-------	.1
Measles	.1	.5
Other	.3	1.0
Trauma and poisonings	6.4	2.0
Neoplasms	.1	-------
General (systemic) diseases, not elsewhere classified	13.4	19.5
Diabetes	1.3	4.7
Vascular diseases	12.0	14.0
Diseases of central nervous system	-------	-------
Other	-------	.7
Prenatal origin	1.6	.5
Etiology undetermined or unknown to science	72.8	71.9
Cataract [3]	35.3	32.5
Glaucoma [3]	14.7	16.5
Other	22.8	22.9

[1] Last eye to go blind. When age at onset was the same for both eyes, but different etiologies were given, etiology for the right eye was used.

[2] A 20 percent sample of those receiving aid. Excludes 63 cases for which a report of etiology was not available.

[3] Excludes cases for which etiology was known and which were placed in appropriate categories above.

SOURCE: Eye examination reports of the division for the blind in the California State Department of Social Welfare.

about half of the cases of known etiology, followed by infectious diseases and accidents (table 4). Diabetes was a more prevalent cause among the women than men, while accidents and syphilis accounted for a higher proportion of the blindness among the men.

Prevention

The etiology of the two major sources of blindness in older persons is unknown. Careful medical supervision and surgery at the appropriate time can, however, restore vision in a large portion of persons with cataract. Likewise, early detection and continued treatment of glaucoma can prevent loss of vision. For many in whom blindness is due to degenerative diseases, such as arteriosclerosis and diabetes (*15*), preventive activities must wait for further advances in medical knowledge (*10*). Fortunately, effective control measures are operating to reduce the toll of blindness caused by many of the infectious diseases such as syphilis, tuberculosis, trachoma, and measles. Ophthalmia neonatorum, which 50 years ago accounted for more than one-fourth of the blindness in school-age children, has, by the routine use of prophylactics at birth, been almost eliminated as a cause of blindness in infants (*16*). Adequate prenatal care, especially in the early months of pregnancy, may help to reduce the numbers of cases of congenital blindness. Educational work in the broad field of accident prevention will also help to prevent the loss of sight due to trauma.

Summary

Studies of the extent and causes of blindness in California indicate blindness in about 3 percent of the persons aged 65 and over who are receiving public assistance. More than half of these recipients of aid became blind after age 65 and about one-third in late middle life. Cataracts and glaucoma together accounted for more than half of the cases, followed by general diseases, infectious diseases, and accidents. Although the specific causes of cataracts and glaucoma are not known, much of the blindness from these conditions can be prevented by careful medical supervision and treatment. Preventive activities under way in the fields of infectious disease control and accidents are hopeful indicators of decreasing incidence of cases of blindness from these causes.

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Glaucoma After Forty

With advancing years as physical activity becomes somewhat curtailed, our ability to read newspapers, books, and to observe television becomes increasingly important to our emotional well-being. Dr. Peter C. Kronfeld, speaking before the National Society for the Prevention of Blindness in Chicago March 28, 1956, indicated that in the population over 40 years of age chronic glaucoma occurs with a frequency of 1 to 2 percent. Unfortunately the silent character of this disease means that unless it is looked for specifically it may have progressed to such a point that it has caused irreparable damage. If it is detected during the first 2 years, the permanent visual damage is slight and a good therapeutic result can be anticipated.

Industrialists have been cognizant, through industrial safety programs, of the need for protecting the vision of those engaged in hazardous occupations, but some of these same industries have offered relatively little to their office and clerical personnel. Those with experience in this field tell me that when eye fatigue is minimized there is an actual increase in employee efficiency with improvement in equanimity. We have not done the many things that could be done to minimize eye fatigue.

—Harold M. Graning, M. D., *regional medical director with the Public Health Service, Region 5, Chicago, addressing the 1956 Middle States Health Conference.*

Occurrence of Influenza July 1955 to June 1956

By Dorland J. Davis, M.D., Dr.P.H.

DURING the period July 1, 1955, to June 30, 1956, the incidence of influenza was comparatively low in the United States. Although influenza A predominated, the small outbreaks of this type were sporadic and localized. There were, however, occasional sharp outbreaks in the east, midwest, and west during the late winter months of 1956. Clinically, the disease was mild, and no unusual mortality was associated with it. Influenza B was reported less frequently than in the previous 2 years. Influenza C was recognized principally in the late winter and early spring.

Of more than usual interest was an outbreak of specifically diagnosed influenza A during July 1955 in a penal institution at Hagerstown, Md. The cases were first noted July 18 and continued for 3 weeks. A total of 350 cases of respiratory illness occurred among 900 inmates, from a number of whom influenza A virus was recovered. No further outbreaks were recognized in the United States until the winter months, although serologic evidence of sporadic infections in military installations was found in November.

In England during December, influenza A infection was diagnosed among American school children at an Air Force base and also in scattered parts of the south of England as outbreaks of relatively mild intensity. A few serologically recognized cases continued to occur during December in the United States.

In January, two sporadic cases of influenza A were diagnosed by virus isolation in the vicinity of Washington, D. C., but the incidence never attained unusual proportions.

During February, localized outbreaks of varying intensity were recognized in upstate New York; Pennsylvania; Cleveland, Ohio; and Illinois. Influenza A virus was recovered from some cases. In Herkimer and Fulton Counties, N. Y., the incidence of influenza was high enough to be reflected in a school absentee rate of 40 percent, but this rate did not obtain in other areas. California reported a number of serologically confirmed cases from the north central part of the State and the San Francisco area.

In March, specifically diagnosed influenza A continued to be recognized from the San Francisco area and also from the southern part of

Dr. Davis for the past 6 years has been executive secretary of the Influenza Information Center, WHO Influenza Study Program in the United States, National Institutes of Health, Bethesda, Md. He is associate director in charge of research, National Institute of Allergy and Infectious Diseases, Public Health Service. In the November 1955 issue of Public Health Reports, Dr. Davis discussed the occurrence of influenza for the period July 1954 to June 1955.

Reporting System

Current information on the occurrence of specifically diagnosed influenza and suspected outbreaks of influenza-like disease is published each week in the Communicable Disease Summary of the National Office of Vital Statistics, Public Health Service, and is distributed to health agencies in the United States and other countries. This is part of a worldwide effort sponsored by the World Health Organization to improve the reporting of influenza and to encourage exchange of newly isolated strains of influenza virus for investigational purposes.

In the United States, research laboratories, hospitals, and Federal and State agencies, including Army, Navy, and Air Force installations, report the observations to the Influenza Information Center of the WHO Influenza Study Program in the United States.

Dr. Carl C. Dauer, medical adviser of the Office of Vital Statistics, Public Health Service, is now executive secretary of the Influenza Information Center. The International Influenza Center for the Americas will continue under the direction of Dr. Keith E. Jensen at the Virus and Rickettsia Section, Laboratory Branch, Communicable Disease Center Activities, Montgomery, Ala.

Isolations of influenza virus and positive diagnostic serologic tests (any technique) reported by civilian and military laboratories participating, continental United States and Alaska

Month and year	Isolation of virus, type			Routine serologic tests, type		
	A	B	C	A	B	C
1955						
November	0	0	0	2	12	0
December	0	0	0	3	5	1
1956						
January	6	0	0	30	4	0
February	14	0	0	73	4	0
March	11	0	1	138	4	6
April	1	0	0	17	0	6
May	0	0	2	4	2	6
Total	32	0	3	267	31	19

California. However, it was not of the same order as that which occurred in 1953 or 1951 and clinically was not severe. Minnesota experienced a low incidence, most noticeable as a respiratory disease outbreak on a hospital ward. Influenza A virus was recovered in several instances. A localized outbreak of rather sharp intensity was also recognized in Hamilton, Mont., during this period. New York and other areas of eastern United States continued to report sporadic cases or small outbreaks.

California continued to report a few cases of influenza A in the month of April. In May, influenza C occurred sporadically at Great Lakes Naval Training Center, Ill., and 2 strains of virus were recovered from patients.

Of interest was the occurrence in Jamaica, B. W. I., of influenza A during December and January. Although the cases were described as moderately severe clinically, no unusual death rate was noted.

The mortality in the United States from all causes and from influenza and pneumonia did not reflect the occurrence of influenza A infection nor show any excess over that expected for winter months.

The strains of influenza A recovered from patients were antigenically similar to each other and to those recovered in the last several years in this country, including the A/FLW/1/52, A/Malaya/302/54, and A/Albany/2/55 strains. Influenza C virus strains were found to be similar to those previously isolated since 1950.

In contrast with the preceding year, no isolation of influenza B virus was reported to the Influenza Information Center, although there were a few reports of serologically diagnosed infection with this type.

The table shows that a total of 32 strains of influenza A virus and 3 strains of influenza C virus were reported as recovered in the United States during this time. By serologic means, 267 specific diagnoses of influenza A, 31 of influenza B, and 19 of influenza C were made. The distribution by months in this table has little significance because of the widespread sources and the small number of reports.

Roentgenographic findings support the conclusion that fluoridation of a municipal water supply results in a substantial reduction in dental caries among children.

Clinical and Roentgenographic Examinations for Dental Caries in Grand Rapids, Mich.

By RICHARD L. HAYES, D.D.S., H. BERTON McCAULEY, D.D.S., and FRANCIS A. ARNOLD, Jr., D.D.S.

DENTAL CARIES experience may be estimated by direct clinical observation, by roentgenography, or by a combination of the two methods. Direct observation is most convenient and is therefore most frequently employed, but the demonstration that bite-wing roentgenography is valuable for early detection of caries in the approximal surfaces of the teeth (*1–7*) has led to its use in several studies (*8–14*), including some in which it was the only method used. The combined technique, direct observation plus bite-wing roentgenography, consistently yields a higher estimate of caries prevalence than direct observation alone (*7*, *10–12*); therefore, some observers have suggested that X-rays are essential for dental surveys designed to determine the efficacy of caries control measures (*8*, *12*, *15*).

In Grand Rapids, Mich., a study to evaluate fluoridation of a municipal water supply as a caries control measure has been in progress since 1944. As part of this study, an investigation was undertaken to determine whether or not supplementing direct observation with roentgenographic examination would affect the conclusions based on direct observation alone. Caries experience was estimated separately by direct observation and by bite-wing roentgenography. The data were then combined in such manner that, if the conclusions were affected, it would be evident, and if not, the finding would be unequivocal. Hence, the method selected for combining the data gives the greater weight to the roentgenographic findings and presents the direct observation findings adversely. The roentgenograms were used also to estimate the depth of the carious lesions.

Dr. Hayes since 1952 has been with the Epidemiology and Biometry Branch, National Institute of Dental Research, National Institutes of Health, Public Health Service. Dr. McCauley, now director of the bureau of dental care, Baltimore City Health Department, Baltimore, Md., was engaged in epidemiological study of oral disease at the National Institutes of Health from 1945 to 1949. Dr. Arnold, a member of the Public Health Service's dental research staff since 1937, has been director of the National Institute of Dental Research since 1953.

Methods

Each year since the start of fluoridation in Grand Rapids in January 1945, selected samples of school children have received direct observation examinations for dental caries. The

examinations are performed by several dentists, using a mouth mirror, an explorer, and artificial illumination (*16*, *17*).

In 1946, 1947, and 1953 (approximately 21, 33, and 105 months after fluoridation was begun), the annual dental examinations of children in the first, fourth, and eighth grades of four selected schools were supplemented by bite-wing X-rays. The X-ray examinations followed the regular examinations by a period varying from a few days to a month. Left and right posterior bite-wing radiographs were made for every pupil. For each fourth-grade child (8–10 years of age), one anterior bite-wing X-ray was made to show the central incisor teeth; for each eighth-grade child (12–14 years of age), three anterior bite-wing X-rays were made to show the incisor and cuspid teeth. First-grade pupils (5–7 years of age) did not receive anterior bite-wing X-rays.

Roentgenographic interpretation was limited to the approximal surfaces of the deciduous

Table 1. Mean number of carious teeth per child as estimated by direct observation and by direct observation plus X-ray examination, Grand Rapids, Mich., 1946–47 and 1953

Type of examination	1946–47		1953		Difference	Standard error
	Mean	Standard error	Mean	Standard error		
	def [1] deciduous molars (ages 5–7)					
Direct observation only	4. 73	0. 27	2. 82	0. 21	1. 91	0. 31
Direct observation plus:						
Minimum X-ray findings	5. 67	. 23	4. 06	. 23	1. 61	. 35
Maximum X-ray findings	6. 19	. 21	4. 92	. 23	1. 27	. 33
	DMF [2] first permanent molars (ages 8–10)					
Direct observation only	2. 77	0. 16	1. 86	0. 13	0. 91	0. 22
Direct observation plus:						
Minimum X-ray findings	2. 78	. 16	1. 93	. 12	. 85	. 21
Maximum X-ray findings	3. 04	. 14	2. 34	. 12	. 70	. 19
	DMF [2] permanent teeth (ages 12–14)					
Direct observation only	9. 66	0. 45	5. 44	0. 36	4. 22	0. 64
Direct observation plus:						
Minimum X-ray findings	10. 96	. 46	6. 50	. 41	4. 46	. 69
Maximum X-ray findings	13. 26	. 50	8. 73	. 52	4. 53	. 78
	DMF [2] premolars (ages 12–14)					
Direct observation only	1. 51	0. 18	0. 38	0. 09	1. 13	0. 22
Direct observation plus:						
Minimum X-ray findings	1. 90	. 20	. 73	. 11	1. 17	. 24
Maximum X-ray findings	3. 34	. 22	2. 08	. 20	1. 26	. 31
	DMF [2] first permanent molars (ages 12–14)					
Direct observation only	3. 93	0. 04	3. 17	0. 12	0. 76	0. 14
Direct observation plus:						
Minimum X-ray findings	3. 96	. 03	3. 30	. 11	. 66	. 13
Maximum X-ray findings	3. 98	. 02	3. 43	. 10	. 55	. 11

[1] Decayed, extraction indicated, or filled.
[2] Decayed, missing, or filled.

molar teeth of 5- to 7-year-old children, the central incisor and first permanent molar teeth of 8- to 10-year-old children, and the permanent teeth (excluding third molars) of 12- to 14-year-old children. Each set of roentgenograms received two independent readings. Each reading was made without reference to the clinical examination record and was recorded separately from the other.

The first step in recording the caries status of an approximal surface was to score it as carious or noncarious. An approximal surface was scored as carious if the reader could detect a discontinuity of the enamel surface or any other sign of caries, such as an abnormal radiolucency at the dentino-enamel junction. These surfaces were designated as the maximum number of carious surfaces detectable by X-ray. Each carious surface was then further examined, and a separate notation was made for each one with signs of caries of the dentin. Surfaces with dentinal caries were designated

Table 2. Mean number of carious approximal surfaces per child as estimated by direct observation and by direct observation plus X-ray examination, Grand Rapids, Mich., 1946–47 and 1953

Type of examination	1946–47		1953		Difference	Standard error
	Mean	Standard error	Mean	Standard error		
	df [1] approximal surfaces of deciduous molars (ages 5–7)					
Direct observation only	4. 48	0. 12	1. 92	0. 20	2. 56	0. 43
Direct observation plus:						
Minimum X-ray findings	6. 11	. 12	3. 79	. 26	2. 32	. 46
Maximum X-ray findings	7. 21	. 11	5. 14	. 29	2. 07	. 47
	DF [2] approximal surfaces of first permanent molars (ages 8–10)					
Direct observation only	0. 56	0. 11	0. 08	0. 02	0. 48	0. 09
Direct observation plus:						
Minimum X-ray findings	. 81	. 14	. 25	. 05	. 56	. 13
Maximum X-ray findings	1. 55	. 16	1. 02	. 09	. 53	. 18
	DF [2] approximal surfaces of permanent teeth (ages 12–14)					
Direct observation only	5. 58	0. 54	1. 90	0. 32	3. 68	0. 68
Direct observation plus:						
Minimum X-ray findings	8. 60	. 68	3. 86	. 45	4. 74	. 87
Maximum X-ray findings	13. 07	. 77	7. 75	. 66	5. 32	1. 08
	DF [2] approximal surfaces of premolars (ages 12–14)					
Direct observation only	0. 63	0. 13	0. 09	0. 03	0. 54	0. 14
Direct observation plus:						
Minimum X-ray findings	1. 38	. 22	. 53	. 11	. 85	. 25
Maximum X-ray findings	3. 43	. 31	2. 33	. 26	1. 10	. 41
	DF [2] approximal surfaces of first permanent molars (ages 12–14)					
Direct observation only	1. 85	0. 16	0. 75	0. 11	1. 10	0. 21
Direct observation plus:						
Minimum X-ray findings	2. 45	. 18	1. 37	. 14	1. 08	. 24
Maximum X-ray findings	3. 34	. 19	2. 46	. 19	. 88	. 27

[1] Decayed or filled deciduous teeth.
[2] Decayed or filled permanent teeth.

Figure 1. Teeth with caries experience, continuous resident children in Grand Rapids, Mich., 1946–47 and 1953.

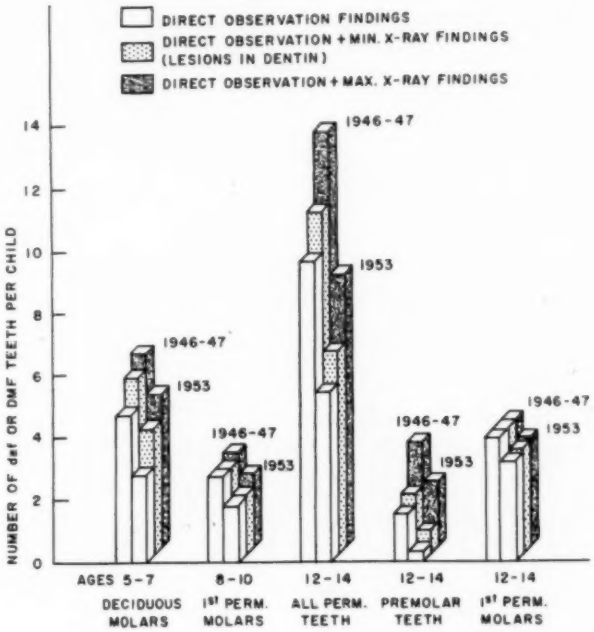
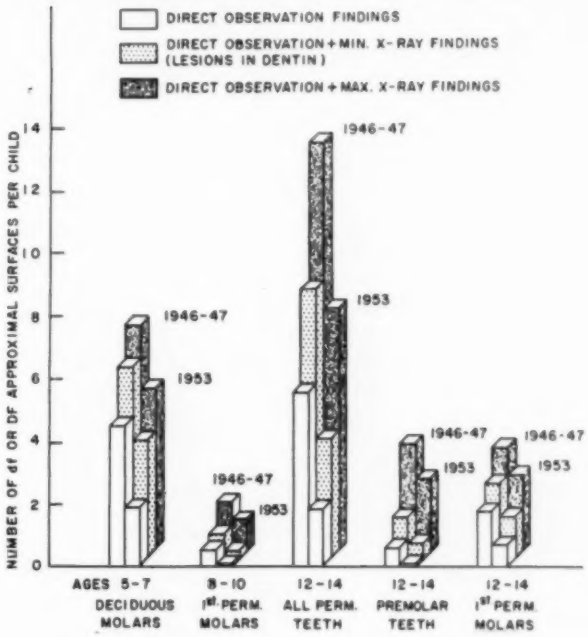


Figure 2. Approximal surfaces with caries experience, continuous resident children in Grand Rapids, Mich., 1946–47 and 1953.



as the minimum number of carious surfaces demonstrable by X-ray. Radiolucencies contiguous to restorations were not recorded, but restorations were considered caries of both the enamel and the dentin.

After the completion of all X-ray interpretations, a master record of the roentgenographic findings was made for each child. This record, which contained the notations from each of the independent readings, was used in combining the radiographic and clinical findings. To give greater weight to the radiographic findings, an approximal surface was given a roentgenographic diagnosis of caries if it was scored as carious at either reading.

Two more records were then made for each child: one for direct observation findings plus minimum X-ray findings; the other for direct observation findings plus maximum X-ray findings. Surfaces negative for caries according to direct observation but positive according to X-ray examination were added to the direct observation findings. Surfaces positive according to direct observation were considered carious at both levels of penetration, regardless of the X-ray findings.

Only children designated "continuous residents," that is, those who had consumed water from the Grand Rapids supply continually since birth and who had not been absent from that community longer than 3 months in any calendar year, were included in the study, although

Table 3. Number of continuous resident children examined with bite-wing X-rays and mean age of children in each age group, Grand Rapids, Mich., 1946–47 and 1953

Age group (years)	1946–47				1953			
	Boys	Girls	Total	Mean age	Boys	Girls	Total	Mean age
5–7	58	50	108	6. 2	70	71	141	6. 4
8–10	50	41	91	9. 1	89	79	168	9. 4
12–14	59	54	113	13. 3	55	60	115	13. 3

Table 4. Mean number of teeth per child subject to the risk of caries, Grand Rapids, Mich., 1946–47 and 1953

Type of teeth and age group	1946–47	1953
Deciduous molars: 5–7	7. 63	7. 77
Permanent teeth:		
8–10	14. 03	13. 76
12–14	26. 80	26. 56
Premolars: 12–14	7. 60	7. 48

others were examined. Of those who received X-ray examination in addition to the regular examination, 736 (312 in 1946 and 1947, and 424 in 1953) met the residence requirements. As there was no essential difference in the caries experience of the 167 radiographed in 1946 and the 145 in 1947, the data for these 2 years were combined.

The representativeness of the X-ray sample was determined by comparing the caries experience of the children in this sample, as determined by direct observation of the teeth, with that of their age peers in the entire sample of children examined in 1946–47 and 1953 (*18*). Between 1946–47 and 1953 both samples displayed substantial decreases in the number of def (decayed, indicated for extraction, or filled) deciduous teeth and in the number of DMF (decayed, missing, or filled) permanent teeth. Both samples yielded essentially the same results.

Support for Clinical Findings

Supplementation of the dental examinations with bite-wing X-rays did not change the basic observation that decreases in dental caries occurred among the Grand Rapids children between 1946–47 and 1953. The mean numbers of carious teeth were smaller in 1953 than in 1947 whether estimated by direct observation alone or by direct observation plus X-ray examination (table 1 and fig. 1). The same was

Table 5. Caries of approximal surfaces, by depth of lesion as determined by X-rays, Grand Rapids, Mich., 1946–47 and 1953

Year(s)	Number of approximal surfaces present	Number of carious surfaces			Number of caries-free surfaces	Number of carious surfaces per 100 surfaces present		
		Total	Caries of dentin	Caries of enamel only		Caries of dentin	Caries of enamel only	Caries free
	Deciduous molars (ages 5–7)							
1946–47	1, 648	756	622	134	892	37. 7	8. 1	54. 1
1953	2, 190	705	503	202	1, 485	23. 0	9. 2	67. 8
	First permanent molars (ages 8–10)							
1946–47	712	131	63	68	581	8. 8	9. 6	81. 6
1953	1, 344	171	38	133	1, 173	2. 8	9. 9	87. 3
	Premolars (ages 12–14)							
1946–47	1, 700	382	144	238	1, 318	8. 5	14. 0	77. 5
1953	1, 692	266	59	207	1, 426	3. 5	12. 2	84. 3
	First permanent molars (ages 12–14)							
1946–47	696	355	240	115	341	34. 5	16. 5	49. 0
1953	838	270	146	124	568	17. 4	14. 8	67. 8

true for carious approximal surfaces (table 2 and fig. 2). Inasmuch as the changes in caries experience for children in this study as determined by direct observation alone were essentially the same as those for all the children in their age groups, it is likely that the rest of the first-, fourth-, and eighth-grade children would provide similar X-ray findings.

The reduction in caries between 1946–47 and 1953 was statistically significant, as can be seen by an inspection of the standard error terms (last column in tables 1 and 2). The reduction cannot be explained by differences in the age or sex distribution (table 3) or by variations in the number of teeth at risk (table 4) since these were all essentially the same for the two periods. The between-method variation in the magnitude of the differences between the 1946–47 and 1953 caries rates might be attributed to chance.

The findings suggest, both numerically and proportionally, that there was little variation in the effectiveness of the clinical examinations between 1946–47 and 1953. The maximum X-ray increments for 12- to 14-year-old children were 3.60 DMF teeth per child in 1946–47 and 3.29 in 1953. If the mean number of teeth in eruption (table 4) is used as the denominator, X-rays revealed the first evidence of caries for 13 percent of the teeth in eruption in 1946–47

Table 6. Approximal surfaces with dentinal caries, by individual and by combined roentgenographic readings, Grand Rapids, Mich., 1946–47 and 1953

Criteria for acceptance of lesions	1946–47		1953		Change in caries experience:[1] Surfaces per 100 surfaces present
	Number of carious surfaces	Number of carious surfaces per 100 surfaces present	Number of carious surfaces	Number of carious surfaces per 100 surfaces present	
	Deciduous molars (ages 5–7)				
Either reading	622	37.7	503	23.0	−14.7
Reading 1 only	595	36.1	479	21.8	−14.3
Reading 2 only	600	36.4	479	21.9	−14.5
Both readings	573	34.8	452	20.6	−14.2
	First permanent molars (ages 8–10)				
Either reading	63	8.8	38	2.8	−6.0
Reading 1 only	56	7.9	34	2.5	−5.4
Reading 2 only	61	8.6	32	2.4	−6.2
Both readings	54	7.6	28	2.1	−5.5
	Premolars (ages 12–14)				
Either reading	144	8.5	59	3.5	−5.0
Reading 1 only	125	7.4	49	2.9	−4.5
Reading 2 only	135	7.9	53	3.1	−3.8
Both readings	116	6.8	43	2.5	−4.3
	First permanent molars (ages 12–14)				
Either reading	240	34.5	146	17.4	−17.1
Reading 1 only	227	32.6	136	16.2	−16.4
Reading 2 only	226	32.5	137	16.4	−16.1
Both readings	213	30.6	127	15.2	−15.4

[1] Minus indicates a decrease in 1953.

and for 12 percent in 1953. Selection of the denominator for these and other proportions is based on Hill's advice concerning numerators, denominators, and proper use of the risk factor (*19*).

New Information From X-Rays

The X-ray data revealed that most of the decrease in caries of the approximal surfaces occurred among the deeper lesions (those involving dentin) and that there was little or no change in the number of shallow lesions (those limited to the enamel). These findings are shown in table 5, where depth of lesion as determined by X-ray is related to the number of approximal surfaces present. The denominators are the numbers of surfaces at risk; they are thus corrected for the slight variation in the number of teeth in eruption but not for any possible variation in time of eruption. Extracted teeth were excluded since there was no way of determining the caries experience of their approximal surfaces.

The difference between the 1946–47 and 1953 caries patterns with regard to depth of lesion is consistent with the hypothesis that fluoride retards the development of dental caries. A reasonable explanation for the data is that some enamel lesions did not progress to dentinal

Table 7. Approximal surfaces with caries limited to the enamel, by individual and by combined roentgenographic readings, Grand Rapids, Mich., 1946–47 and 1953

Criteria for acceptance of lesions	1946–47		1953		Change in caries experience:[1] Surfaces per 100 surfaces present
	Number of carious surfaces	Number of carious surfaces per 100 surfaces present	Number of carious surfaces	Number of carious surfaces per 100 surfaces present	
	Deciduous molars (ages 5–7)				
Either reading	134	8.1	202	9.2	+1.1
Reading 1 only	116	7.0	181	8.3	+1.3
Reading 2 only	125	7.6	200	9.1	+1.5
Both readings	106	6.4	178	8.1	+1.7
	First permanent molars (ages 8–10)				
Either reading	68	9.6	133	9.9	+0.3
Reading 1 only	66	9.3	125	9.3	0
Reading 2 only	63	8.8	118	8.8	0
Both readings	61	8.6	110	8.2	−.4
	Premolars (ages 12–14)				
Either reading	238	14.0	207	12.2	−1.8
Reading 1 only	231	13.6	184	10.9	−2.7
Reading 2 only	204	12.0	196	11.6	−.4
Both readings	198	11.6	173	10.2	−1.4
	First permanent molars (ages 12–14)				
Either reading	115	16.5	124	14.8	−1.7
Reading 1 only	115	16.5	114	13.6	−2.9
Reading 2 only	101	14.5	118	14.1	−.4
Both readings	101	14.5	108	12.9	−1.6

[1] Minus indicates a decrease in 1953; plus, an increase.

lesions and that many enamel lesions did not occur or at least did not develop to a size detectable by practical methods. (Some enamel lesions might have been replaced by microscopic lesions of the type described by Burket (*20*); this study did not investigate these lesions). The nonappearance of the shallow lesions is also consistent with the hypothesis that fluoride actually prevents the inception of caries. The alternative hypothesis that fluoride selectively prevents caries of the dentin is not supported by these data, as this hypothesis would require decreases in dentinal caries to be balanced by increases in enamel caries.

Effect on DMF Studies

Bite-wing roentgenography produced less change in estimates of caries experience of teeth (DMF or def) than that of approximal surfaces (DF or df). This can be seen by comparing parallel radiographic increments of these scores in figures 1 and 2. The lower sensitivity of DMF estimates is related to the high susceptibility of children's teeth to occlusal caries (*21*), the relative ease of detecting occlusal lesions by direct observation (*2*), and the fact that a tooth is counted only once in arriving at a DMF score. Only radiographic evidence of caries in a tooth deemed to be free of caries on direct observation would add to a DMF score.

The methods selected for combining the direct observation and roentgenographic data did, in fact, present the direct observation findings adversely, as can be seen in figures 1 and 2. As shown in tables 6 and 7, different methods of using the two independent X-ray readings would have led to the same conclusions: that there was a substantial decrease in dental caries experience and that this decrease occurred primarily among the deeper lesions. The essential conclusion—that there was a substantial decrease in dental caries experience—was reached without the X-rays.

Summary

Bite-wing roentgenography was used to supplement the regular dental examinations of 736 continuous resident children of Grand Rapids, Mich., in 1946–47 and 1953. Findings from direct observation indicated that the children in the X-ray sample were representative of their age peers in the entire sample of children examined in those years.

The roentgenograms were read for radiolucencies of dentin and for discontinuities of the enamel surface. For the primary purpose of testing the effect of X-ray findings on conclusions reached by direct observation alone, the X-rays were read twice and any surface scored as carious at either reading was added to the directly observed estimate of caries.

There were wide but consistent variations in total caries experience according to the three methods of estimation, but all estimates demonstrated a significant decrease in total caries experience between 1946–47 and 1953. The decrease in caries appeared to be greater for deeper lesions than for shallow lesions. This was demonstrated by analysis of roentgenographic data without reference to the regular dental examinations and was independent of the method used to combine the two X-ray readings. The decrease in the deeper lesions without a balancing increase in the shallow lesions suggests that fluoride retards the development of caries and that it also prevents the inception of caries.

From this study, we draw the following conclusions:

1. Roentgenographic findings support the clinical finding that fluoridation of a municipal water supply is an effective caries control measure.

2. Estimates of dental caries experience expressed as the number of decayed, missing, or filled teeth are less sensitive to modification by roentgenographic findings than are estimates of caries expressed as the number of decayed or filled approximal surfaces.

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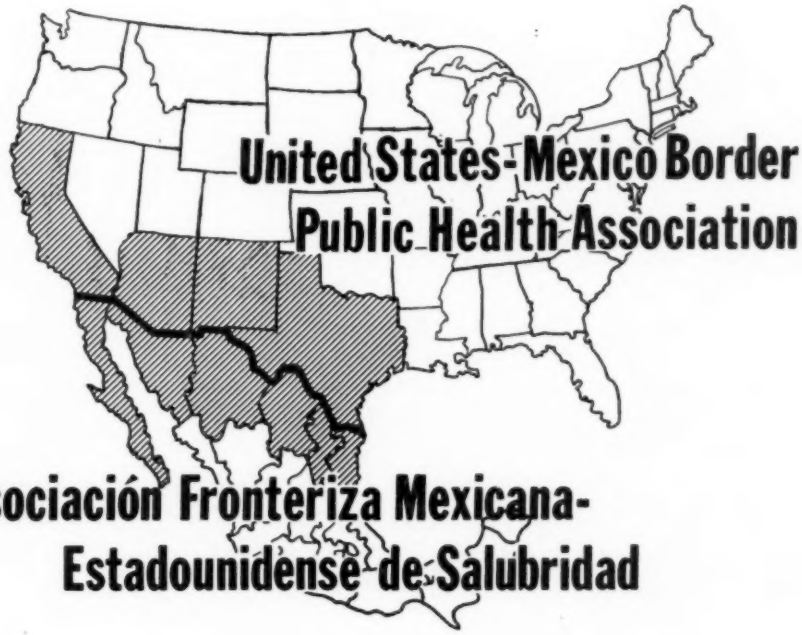
CONFERENCE REPORT



In the light of the needs for health services in the border region of the southwest, organized health officials there have recommended that official agencies underwrite a survey and evaluation of conditions as a guide to future action. At the same time, they have undertaken in an exemplary manner to help each other in dealing with responsibilities which respect no jurisdictional barriers. The following information, based on papers presented at the 14th annual meeting of the United States-Mexico Border Public Health Association, indicates both the challenges and achievements in this territory. The meeting was held April 13–16, 1956, jointly in California and Baja California in the border cities of Calexico and Mexicali.

MUTUAL AID

THE INTERNATIONAL BOUNDARY area between the United States and Mexico is unique, for here we have two cultures, representing striking contrasts in language, socioeconomic conditions, and technological development, confronting one another across a practically unguarded and, for the most part, sparsely settled border more than 2,000 miles in extent.

In order to foster understanding of public health needs and through mutual assistance to promote public and personal health along the United States-Mexico border, the United States-Mexico Border Public Health Association was organized in 1942 with the encouragement and assistance of the Pan American Sanitary Bureau. This official international health organization has continuously furnished our association with an executive secretary, who is also chief of the El Paso (Tex.) field office of the bureau.

During the past year two major accomplishments of the association were the bi-State meeting of California and Baja California, Mexico, and the Special Study Committee Conference recommendations on a proposed border evaluation study of health conditions and resources.

At the bi-State meeting of California and Baja California, more than 100 persons from local, State, and Federal health agencies, as well as social welfare and voluntary health agencies, participated in the deliberations.

This was the first bi-State meeting sponsored by our association.

The need for potable and adequate water supplies, safe sewage disposal, careful control and management of food supplies, safety factors in housing and employment, and in air pollution received special attention.

The lack of adequate sanitary facilities for field workers in agriculture and the great need for careful study of working and living conditions of the migrant agricultural laborer and his family were emphasized.

The language barrier was mentioned as one of the problems of the maternal and child health program. It was suggested that incentive pay for bilingual health workers might help solve this difficulty.

An intensive program of investigation, education, and publicity was advocated in tuberculosis and venereal disease control.

The special study committee recommendations on a proposed border evaluation study of health conditions and resources were developed after much correspondence.

These recommendations have been submitted to the respective Federal departments of health and the Pan American Sanitary Bureau.

Other activities of interest to and stimulated by the association, either directly or indirectly, included the following:

Interchange of ideas and opinions regarding a border field training program and the possible establishment of a permanent field training center.

Tijuana, Baja California, and San Diego, Calif., both contributed to the cost of chlorination of the sewage effluent emptying into the Tijuana River as negotiations and discussions continue for a permanent solution of this pollution problem.

Meetings between Mexicali and Imperial County health officials were held with discussions referring to diarrhea, venereal disease, and the education and training of personnel.

Along the Arizona-Sonora border, in the area of Nogales, Naco, Agua Prieta, Bisbee, and Douglas, working relationships were established between the local health officials to control venereal disease.

El Paso, Tex., and Juarez, Chihuahua, joined in a mosquito survey in the two municipalities.

Personnel from Laredo, Tex., collaborated with the health officials of Nuevo Laredo, Tamaulipas, in carrying out a sanitation survey of that neighboring city.

From the address of George W. Marx, C.E., M.P.H., president of the association and director and chief engineer, bureau of sanitation and sanitary engineering, Arizona State Department of Health.

BORDER HEALTH CONDITIONS

The multiple complexities peculiar to public health services in semiarid lands, reviewed in the president's address, were dealt with separately by other speakers whose remarks here are grouped roughly in categories concerned especially with sewage disposal; the zoonoses; general sanitation, with special reference to the needs of migrant labor; health education; rehabilitation; and communicable diseases, in that order.

Sewage disposal presents unusual complexities in the southwest border region. Water for carriage and dilution usually is limited by an arid climate. Water used for sewage is used also in many places for irrigation. The irrigation ditches in dry seasons and the fields themselves, when they are occupied by armies of field hands, are fecal depositories. Contamination of the fields poses a possible threat to the consumer of raw vegetables harvested there and increases the incidence of beef tapeworm, an expense to the cattle grower and a hazard to the health of consumers of raw or slightly cooked, uninspected beef.

Contamination by body wastes is a factor that enters also into the comments on the management of housing, both for permanent and transient residents; education to reduce infant mortality; and certain communicable diseases. Another pervasive theme in these comments, most evident with respect to health education and community organization, is the way difference in language and tradition affects health practices and attitudes. The last papers summarized below deal with microbial infections, which in many parts of the United States have ceased to be of major concern but which still persist as threats to the people of the border.

Irrigation With Sewage Impractical for Safety

The question of the use of sewage for irrigation was analyzed thoroughly by G. R. Herzik, Jr., chief engineer of the Texas State Health Department, represented by Frank J. Von Zuben, chief of general sanitation. Referring to the Willem Rudolfs (Rutgers) study, commissioned by the United States Army Quartermaster, he acknowledged that under careful control lands irrigated with sewage can produce vegetables acceptable for human consumption, but he held that such controls pose operating obstacles that "in practice are virtually insurmountable."

Beyond all controls on the farm, the Rutgers study concluded that "the only reliably effective method for decontamination, with respect to bacterial as well as helminthic organisms, is . . . pasteurization at 60° C. Not only are all the undesirable organisms killed, but the quality of the vegetable is not injured," he said. But this precaution, too, seemed impractical for the homemaker. In June 1952, the Texas Board of Health prohibited sewage for irrigating food crops which might be consumed in the raw state.

Herzik spoke in favor of using treated sewage on fields used for animal feed or pasture or in connection with soil conservation work provided stream pollution is avoided. He does not believe wet or air-dried sewage sludge should be used to fertilize crops intended for human consumption.

Clean Water In Mexico

Against this background, P. J. Caballero, sanitary engineer, Office of Hydraulic Resources, Mexico, reviewed sewage disposal facilities in the Mexican watershed of the Rio Grande. Two international plants are in operation, and others are in construction. Most of the Mexican cities have sewers. No plants in the watershed have treatment facilities, but their sewage is impounded before it reaches the Rio Grande. Lands irrigated with sewage are for the most part used to grow cotton, he said.

The most acute condition is created outside the Rio Grande Valley at Tijuana, Baja California. The Tijuana River carries sewage from that city through United States territory and contaminates California beaches.

At Mexicali, Baja California, and Calexico, Calif., treatment facilities in construction include 62 acres of oxidation lagoons with the possibility that the effluent may be used for irrigation or for washing salted land.

Tapeworm Hazard In Dry Lands

The animal stake in sewage disposal was described by Donald Miller, D.V.M., veterinarian in charge, Animal Disease Eradication and Animal Inspection and Quaran-

tine Branches, Agricultural Research Service, United States Department of Agriculture. Changes in farming and irrigation practice, he said, have multiplied the possibilities of exposure of livestock to the larval form (*Cysticercus bovis*) of the beef tapeworm (*Taenia saginata*). To determine the prevalence of the parasite in humans, especially ranch and farm laborers, he recommended laboratory examination of stool specimens, as clinical symptoms of tapeworm often are vague. He specified microscopic examination of three daily stool specimens, run through a sieve and centrifuged or floated with a concentrated salt solution.

Exposure of the American public may be judged by the following facts: About 65 percent of the beef consumed in the United States is examined by inspectors of the Federal Meat Inspection Service. The records indicate that, in 1912, of the cattle inspected 0.14 percent were infested with *C. bovis*. In 1930, the percentage was up to 0.37. In 1945, it was 0.6. From 1951 through 1955, the nationwide occurrence of *C. bovis*, as indicated by the number of carcasses ordered to be retained for treatment by freezing, was at a rate that declined from 0.142 to 0.073. In Arizona, the rate has declined from 4.5 in 1945 to about 0.5 in recent years.

Such percentages are little consolation to the cattle owner who may encounter an outbreak in a cattle feed lot. Such an outbreak may result from careless disposal of the feces of a single carrier. And if the cattle do not undergo inspection at time of slaughter, the hazard may be transmitted to eaters of raw or lightly cooked meat.

In 1955, inspectors at a slaughterhouse found more than two-fifths of a single herd of 1,980 cattle, pastured and pen fed in Arizona, were infested, 16 so heavily that they had to be condemned. The other infested cattle were held for freezing, at a substantial loss to the rancher.

C. bovis in beef cattle has been associated with fecal fields used subsequently for pasture; with irrigation of pastures by primary sewage effluent; with ground feed from freight cars contaminated by transient laborers; and with direct contamination of irrigation ditches by ranch workers.

South African studies indicate that pastures may remain infective for as long as 2 years after deposition of *C. bovis*. Other studies, however, have found infections without indication of a probable source.

Research in the field now seeks to determine accurately the age of *C. bovis* cysts found in bovine muscle; how soon such cysts may be found after ingestion of viable eggs; at what age such cysts are infectious; and, if possible, methods to improve control of the parasite.

A critical but relatively simple step in such control, Miller concluded, is the diagnosis and treatment of human carriers of *T. saginata* by physicians and public health agencies, especially in the neighborhood of pastures or feed lots. Another basic step is comprehensive inspection of meat slaughtered for market. In addition to providing privies, latrines, or other suitable facilities for hired hands, Miller emphasized, cattlemen should refrain from employing raw sewage for irrigation of pastures and should support programs to develop sanitary habits by education.

Brucellosis Control Gains With Vaccine

Veterinary services to public health in southern California were outlined by J. E. Stuart, chief, division of animal husbandry, California State Department of Agriculture.

Since 1940, all counties in the State have been classified as having less than 0.5 percent tuberculosis. Total herds which number more than 56,000, with a total of more than 3,500,000 head, have been tested. Actual tests show that reactors in recent years have amounted to less than 0.2 percent. About 650,000 cattle in 17,000 herds are tested annually by veterinarians employed in the agriculture departments of California and the Federal Government.

California's program for brucellosis control consists of requiring vaccination of female dairy calves. Vaccination of other calves is offered but not required. Since this program began, in 1948, more than 2,400,000 calves have been vaccinated, one-third on a voluntary basis. The aim is eventually to have herds consist wholly of vaccinated animals. About 9 of every 10 head in the State now have been vaccinated.

Infection in State dairy cattle has been reduced in 8 years from 18 percent to less than 5 percent. More than half of the herds are completely negative, on the basis of a milk ring test conducted last year with a mobile laboratory. The national goal is a rate of infection of less than 1 percent, with infection present in less than 5 percent of the herds.

Movement of dairy cattle, except for slaughter, is forbidden by the State unless the cattle test negative or have been vaccinated. The State furnishes desiccated strain 19 for vaccination without cost, and pays accredited veterinarians for doing the vaccinating.

A voluntary brucellosis program is applied to swine.

Following the 1952 outbreak of vesicular exanthema, as a preventive measure, a cooking program was inaugurated and since November 1955 all garbage fed to hogs has been cooked. Incidental effects of this program, which includes other sanitation measures, has been to reduce the hazard of trichinosis, reduce fly breeding, and reduce rat breeding. Outbreaks of vesicular exanthema have been reduced from 49 in 1954 to 15 in 1955. It is believed the cycle of this disease has been broken in California.

Other zoonoses commented upon by Stuart included anthrax, ornithosis, salmonellosis in turkey flocks, tapeworm, and rabies.

Lettuce Pickers Try Sanitation on Wheels

Opportunities for improving sanitation among harvest workers were described by Edward W. Munson, director of sanitation in California's

Monterey County Health Department.

Many harvest workers, formerly stationed at sheds where they culled, packed, and iced vegetables trucked in bulk from the fields, now do their work with the use of cardboard containers and vacuum cooling at the picking site. This increase in the numbers of field workers has multiplied the need for toilets and lavatories, drinking water, and protection from excessive dust in the harvesting of fruit and vegetable crops.

After a survey of the needs, county health officials, under instructions from the State, proceeded to develop a pilot program of corrective measures, with the full cooperation of the Growers-Shippers Vegetable Association. The device most favored, after consideration of alternatives, was a mobile chemical toilet, with running water, a wash basin, paper towels, and soap, provided by the shipper for each harvesting crew. The units are housed in light steel, with an open metal floor, mounted on wheels for towing. A 50-gallon tank of water is fabricated into the top or back of the unit to supply the handwashing basin. Drinking water will be supplied with paper cups or with portable fountains. The units will be inspected regularly. The next step is to appraise their value in use.

Border Population Moves and Grows

A general appraisal of sanitation needs in Mexico's border territory, by Joaquin Segura, sanitary engineer, Mexican Public Health Service, emphasized population growth, with a movement to urban centers. In recent years, several border cities have grown from a few hundred souls to tens of thousands. Progress in sanitation has been accompanied by a rapid decline in infant mortality in the border cities: from 266.4 per 1,000 in 1901 to 95.8 in 1950, with still some distance to go.

The health needs of the transient agricultural worker, or those who move to settle in rural areas north of the border, are complicated by a strange environment, language difficulties, temporary housing, frequent change of locale, and by weather, altitude, and temperature conditions unfamiliar to the migrant. Such families also may be susceptible to pathogens which they encounter for the first time in a new environment.

Slum Clearance Project In Mexicali Area

A specific example of the management of a slum area in Mexicali, Baja California, was described by Enrique Ramirez del Toro, engineer in the Coordinated Health Services in the State of Baja California. As Mexicali achieved new growth, more than 10,000 people lived in the "New River" neighborhood, below sea level, subject to periodic floods, both from rains and sewers.

A flood in January 1955 brought the threat of an epidemic, which was met by the decision to evacuate the area. Families were quartered in private buildings and in schools, with food, clothing, and medicines provided by the government.

Health officials directed installation of cesspools, removal of domestic animals, installation of portable baths, immunization, and spraying of occupied buildings.

To provide permanent quarters for the families, the government awarded to each of 2,769 housewives a lot of 150 square meters in a neighborhood with a central park, planted with grass and flowers. Safety lanes are provided for pedestrians, and three zones are reserved for schools. The government also erected sample houses to stimulate private capital to invest in low-cost expandable homes, with hygienic facilities.

The former slum is now the site of the city's main sewer, known as the "Great Collector."

Cross-Border Projects Coast to Coast

Such joint concerns as the health of migrant families are the basis of cross-border health projects reviewed by Dr. David M. Cowgill, director of the Cameron and Hidalgo County Health Units, San Benito, Tex. These enterprises are in progress all along the border from the coast of California to the mouth of the Rio Grande. Specifically described were those of San Diego-Tijuana, Imperial County-Mexicali; El Paso-Juarez; Eagle Pass-Piedras Negras; Laredo-Nueva Laredo; and Cameron County-Matamoros area. Conspicuous among the joint projects were programs of sanitation, health education, vector control, water pollution control, prevention of venereal disease, and tuberculosis surveillance and treatment.

Farm Placement Prevents Infection

Health conditions of Mexican migrant workers were discussed in a review of the medical aspects of the farm placement program in charge of Dr. Harold D. Lyman, medical director, Public Health Service, El Paso, Tex.

There are four migratory stations south of the border. Migrants are examined at these stations by Mexican physicians and are vaccinated against smallpox by Mexican nurses. The examination selects those who are fit for hard labor and free from contagious or mental disease. Transportation is supplied to the five reception centers on the border, namely, El Centro, Calif.; Nogales, Ariz.; and El Paso, Eagle Pass, and Hidalgo, Tex.

The reception centers apply disinfestation, screen and treat venereal disease, and take a 70-mm. chest X-ray of each migrant. Medical care, including hospitalization if necessary, is also provided. Since inception of the program in 1951, authorized by Public Law 78, 82d Cong., the total number processed has increased from 124,000 to more than 400,000 a year. A peak of 500,000 Mexican farm workers is anticipated for 1956.

About 3 percent of the applicants were rejected in 1955 at migratory stations and half as many more at the reception centers. The X-ray

screening resulted in rejection of 1.1 percent of the applicants. More than half of these are in the minimal stage of tuberculosis, a few far advanced.

Reception Centers Screen Migrants

Dr. Victor Ocampo Alonzo of Mexicali, health officer for Baja California, reviewed operations of the agreement between the United States and Mexico at reception centers. He pointed out that workers rejected for reasons of health put an unanticipated burden on the cities where they are sent for repatriation. He observed also that the arrival of large numbers at the reception centers creates health hazards when there is a lack of facilities and organization to provide for them.

While he acknowledged that many workers rejected at the placement centers should have been stopped at the Mexican migratory center, he observed also that many migratory workers, found fit at the migratory center, are likely to suffer en route from lack of sanitation or lack of consideration given to the transportation of workers by railroad or highway. He spoke of movement of workers without toilet facilities or drinking water. For lack of nourishment, he said, many arrived in a starving condition, easy prey to acute communicable disease, exposed to sunstroke in summer and to freezing in winter.

Management of migration has improved, however, to the extent that the number of wetbacks or wirejumpers has declined from 565,000 in 1951 to 20,000 in 1955.

Investigation of Diarrhea In a Migrant Labor Camp

A report of an epidemiological investigation of shigellosis in an Arizona migrant farm labor camp in which *Shigella* was recovered from flies and feces deposited on the ground was offered by Paul J. Coleman, M.D., epidemiologist, and Paul P. Maier, M.P.H., sanitary engineer, of the Phoenix (Ariz.) Field Station, Communicable Disease Center, Public Health Service.

During the period November 15–30, 1955, 13 individuals from 3 households in a camp of approximately 100 inhabitants were hospitalized. Since all 3 families gave histories of illness prior to arriving at the camp, opportunity for intrafamilial spread existed. *Shigella* was isolated from 8 of the patients and, during the normal population survey of the workers, from the operator of a chuck wagon who served workers in the field. *Shigella* was isolated from 7 of 37 fly pools (18 percent) and from 9 of 36 (25 percent) of cultures obtained from fresh deposits of human feces on the ground.

All organisms typed were *Shigella flexneri* 3, which was the only pathogenic organism isolated during the investigation. The history of one affected family suggests that the original infection may have been carried from Seattle, Wash., to Arizona. Environmental conditions in the camp were conducive to the high fly population, and these vectors probably contributed substantially to the mild cases and subclinical infections reported from other inhabitants of the camp.

Curb Diarrheal Deaths In Texas Infants

In 1948, it was noted that six counties in Texas contributed less than one-fifth of the live births but almost half of the deaths from infant diarrhea.

Ruby M. Lee, R.N., M.A., public health nursing consultant, Texas State Health Department, said Texas has reduced infant mortality because it expanded educational activities of organized health services, increased sanitation work, and established additional well-child conferences and nursing services with the assistance of many public and voluntary agencies.

Among specific measures employed, a public health nurse visited each home where a midwife delivery was reported on a birth certificate. These visits directly increased attendance at well-child conferences, and severe diarrhea incidence in infants subsequently declined. The counties which formerly contributed half of the deaths from infant diarrhea now contribute a fourth.

Further reduction, Lee reported, would depend on early case finding, prompt diagnosis, early initiation of medical and nursing care, and education.

(In one of these counties, experimental fly control programs conducted by the Public Health Service contributed to reducing the mortality from infant diarrhea for the period under study.)

Lee reported that the number of pit privies in one city was reduced from 2,500 to 15, by a concerted drive, but that a new annex subsequently increased the number to 600.

Shigella Finds Ideal Environment

That Mexican migrants are not the only members of the mobile population in need of protection and health education was the implication of a report by Don Suggs, public health engineer, Los Angeles County Health Department, on an epidemic of shigellosis in a trailer village. Among residents of this village, at the time of a survey, craftsmen were predominant, followed by service workers, professional and white collar workers, and the semiskilled. Only three were classed as laborers and one resident was from the United States Army.

More than a third of the residents had been there less than 2 months, but nearly a fifth had been in residence a year or more, a few for more than 5 years.

Despite intensive efforts of the health department, two separate *Shigella* epidemics occurred in the trailer village within a period of 8 months.

Food and water supplies were free from contamination at the point of delivery. Running water was supplied each kitchen sink. Water flush toilets and sewer-connected laundry facilities were available in two community buildings. Very few of the trailers had individual toilets.

Nevertheless, the premises, heavily populated with children, favored

spread of the epidemic by personal contact. Children played freely in the garbage storage and overburdened toilet and shower rooms.

In the laundry rooms, the rinsing of soiled diapers proceeded while children were being washed, sometimes in the same tub. The 27 toilets were used by more than 400 individuals of whom more than 160 were not yet 10 years old. Many trailer residents also used chambers and charged their children with the duty of disposing of the contents, a duty they performed somewhat whimsically. Often the children emptied chambers into laundry tubs and neglected to flush them. Children rarely washed their hands after emptying the chambers.

Those infected by *Shigella* could not be isolated. The abundance of flies and the lack of screening also encouraged propagation of the infection.

The report concluded that trailer court operators should be helped to overcome conditions which tend to make the villages an incubator of infections, that legislation enacted by the State would help to strengthen health department authority with respect to housing in trailer camps, and that all public health services should be applied to help residents of trailer villages shoulder their responsibilities.

After the report was written, other outbreaks of a similar nature were reported in other trailer courts within the county jurisdiction. These outbreaks also occurred in trailer courts having a large number of children with consequent overcrowding and misuse of the community toilet and laundry facilities.

Nurse Recommends Democratic Tactics

To illustrate practical techniques in an educational campaign for implementing community health programs, Hazel Shortal, public health nursing consultant, Region 9, San Francisco, described hypothetical situations.

"Successful and sustained efforts to reduce the maternal and infant deaths," she said, "would depend on improving the care of mother and child through adequate food, education, and medical and nursing care during pregnancy and infancy.

"Let us develop two widely different plans. In the one instance, let us say that it is decided that quick action is necessary and therefore a team of experts will be sent to the community, responsible for the organizing, directing, and operating on a demonstration basis a program of improved care for mothers and children. The team will bring the materials, supplies, and moneys. Thus equipped, changes can readily be accomplished, and success assured. Meetings will be called for the purpose of informing the people of the services that have been brought to them. Local people will be expected to respond to this generous effort of the government, and soon the experts will observe gratifying results.

"In the other instance, representatives from the Ministry of Health sent to the community will seek out the leaders in the various local groupings. The facts of maternal and infant mortality in the community will be discussed. Efforts will be made to gain the understanding of these leaders in regard to the problem, and to give the Ministry representatives something of local attitudes and behavioral patterns. Plans will be developed only after the local leaders accept their role in arriving at a solution of the problem. A service for mothers and babies will be established when the community decides that this is desirable. The Ministry will supply medical and nursing participation in the service upon request of the community. Local leaders announce the plan.

"Approval of the project by the local padre is signified by his offering physical facilities for holding clinics. Midwives will participate in the clinics by offering assistance to patients in preparing for the physical examination. The *curandero* will interpret reactions and attitudes to the physician, and, in turn, the medical recommendations to the patients. The physician and nurse will spend time with all concerned after the clinic sessions answering questions and increasing their knowledge of cultural settings in the community.

"When the problem of a more adequate diet is realized, this community itself will make the determination that help is needed and ways will be explored for effective implementation of a farm improvement program. When the community sees opportunities for initiating health practices through the schools and perceives the value of the educated person as a contributor to improved living in the community, adequate support of school programs can be expected.

"In both settings the stated objective may be reached; that is, reduction of infant and maternal deaths.

"The first situation may even eventually be taken over with local community sponsorship, but the planning described cannot be said to stimulate local interest, and the likelihood of the program surviving the stay of the team experts is not great. In the second instance, in which each step in the development of the program was a local decision and supported by responsible local leaders, only technical guidance was needed from the Ministry representatives. Pride in development and responsibility for action rested with the local groups. Satisfaction in a job well done will be sensed by the local people as well as the representatives of the Ministry."

Handicapped Children Need Coordinated Services

In an effort to guide growing communities in the development of services for children, Dr. Marcia Hays, chief of the bureau of crippled children's services in the California State Department of Health, reviewed early American practice as she outlined requisites for initiating coordinated services locally. She told how Americans first attempted to aid handicapped children by bringing them to medical centers, where they received the most expert medical attention the department could provide.

"Often because of the chronicity of the disability or infection, the incon-

venience of transporation, and the lack of services in the home community, a child remained in the center 1, 2, or 5 years. The family reorganized its life without their child, and the child grew without a family. And then abruptly when we felt our work was done, the child was discharged and returned to what had been his home. But this was not the same child to his family, and they were not the same family to the child, and what we called 'the adjustment' was slow, painful, and confusing to both the child and the family. Sometimes it would not be made, and so, as in more than one instance, we found the child later in the State school for delinquents. So our first approach, based on a well meaning desire to place fine medical care above everything else, was modified.

"Now in the development of services we are guided by a principle which has become as important as fine medical care: We say that the child is first a child in his family and he belongs at home. Where it is not possible to plan his care so that he may be at home, we bring parents and child together as often as possible, and we limit the time away from home so that separation cannot be established . . .

"Children need coordinated services in the home community, or reasonably nearby. To initiate them, neither definitive specialization nor the ultimate in buildings and equipment is a necessity. Good core services, built around perhaps a graduate physician and a qualified teacher —each with an understanding of parents and children, their needs and pattern of growth—should be the first step. And once these are established, attracting other disciplines and specialized skills to the community becomes a matter of proper timing."

Sociologist Discusses Cultural Factors

Lyle Saunders, associate professor of preventive medicine and public health at the University of Colorado School of Medicine, called attention to cultural factors that complicate the work of health agencies in border agricultural areas. Differences in social origin and cultural conditioning between professional and technical personnel and members of the public they serve hamper communication and make difficult the coming to agreement on health goals and the means for reaching them.

Cooperation across an international border, Saunders suggested, is further complicated by differing administrative philosophies, political traditions, governmental systems, and by a disparity in economic resources. He urged that public health agencies seek the collaboration of social scientists on programs where cultural or subcultural differences may be hindering factors.

Penicillin Prevents Neisseria gonorrhoeae

The question of resistance of *Neisseria gonorrhoeae* to penicillin has been raised by physicians who have found positive smears taken from prostitutes who have received weekly doses of the antibiotic.

Dr. Mariano Curiel Alcala, chief of the venereal disease control program in Mexicali, Baja California, noted that injection of 300,000 international units of aluminum monostearate penicillin assures blood levels of the drug effective against *N. gonorrhoeae* for 96 hours. As the incubation period is generally 72 hours, weekly injections of that dose are assumed to be effective in preventing the disease.

Braulio B. Ramirez of the Institute of Hygiene, Mexicali, reported use of a medium of agar and cactus gum to culture 100 samples of cervical secretions from prostitutes under prophylactic control. Smears were taken from the colonies. Each of the subjects had taken 300,000 international units of aluminum monostearate penicillin weekly for at least 3 weeks before the test.

All but one culture were negative. The smear taken from the one positive culture was negative. He concluded that *N. gonorrhoeae* is not resistant to penicillin as applied by the department to prostitutes for months or even years.

Poliomyelitis Surveillance Pursued in Mexico

A report of a 1955 outbreak of poliomyelitis in Mexicali, Baja California, by Dr. Jose Reyes Ruiz, epidemiologist, Baja California State Health Department, stated that all of 24 cases reported occurred within the first 3 years of life. This evidence coincided with findings of an extensive epidemiological survey by Dr. Carlos Calderon and others in the Federal Department of Health in Mexico, who stated that from 1945 to 1954, 93 percent of the poliomyelitis patients identified were less than 5 years of age.

Calderon's report found a higher incidence of paralytic cases in families of very low income than in families of acceptable or good monthly income, 1.75 against 1.1 per 1,000 families. Differences in family sizes were not reported. The finding, contrary to experience in other countries, is attributed to crowding, on the ground that the infection is assumed to be a consequence of person-to-person contact.

Eight-Year Campaign To Wipe Out Malaria

On the premise that limited DDT applications may encourage the rise of resistant malaria vectors, Mexico has launched a drive which is intended to eradicate malaria in 8 years and to maintain a surveillance system to prevent reinfection of carriers.

Dr. Manuel E. Pesqueira, Sub-Secretary of Health of Mexico, stated that, at present, malaria is found in three-fourths of Mexican territory, with 16 million inhabitants. Malaria parasites, third cause of death in the nation, produce fevers in about 2 million patients, with a mortality of more than 1 percent. The disease is most common in the Tehuantepec Isthmus.

The drive is in charge of the National Commission for the Eradication of Malaria, presided over by the Secretary of Health and Welfare. Technical assistance is provided by the World Health Organization, and the United Nations Children's Fund will contribute insecticides and equipment. The main financial contribution, 150 million pesos for personnel, comes from the Government of Mexico.

Tuberculosis Control South of the Border

Dr. Fidel Perez Servin described services in the tuberculosis clinic of Ciudad Juarez, Chihuahua, which provides screening, observation of doubtful cases, and treatment. The major difficulty faced there is control of the ambulatory patient. As a rule, such patients need to work to support their families, under conditions which prevent them from observing prophylactic instructions even if they are so inclined.

Dr. B. Aranda Reyes described services of the phthisiology department of the Federal Department of Public Works hospital in Mexicali Valley, Baja California, which, he said, had the highest tuberculosis mortality in the country, 12.6 deaths per 10,000 inhabitants. Screening and hospitalization services are limited by the fact that patients cannot afford the expense of a trip to the center and by the shortage of available beds.

Where Aegypti Persists, Yellowjack Threatens

Dr. J. Austin Kerr, special expert in yellow fever and related virus diseases, Pan American Sanitary Bureau, Washington, D. C., reviewed events stemming from the epidemic of yellow fever which began in 1948 in Central America. Yellow fever had been limited to the jungle there, because *Aedes aegypti*, the urban carrier of the virus, had been eliminated from the towns.

However, as the infection moves north through the jungle, leaving a trail of dead monkeys, it is expected to enter the Mexican states of Chiapas, Tabasco, and Veracruz, where *A. aegypti* may pick it up.

The presence of this mosquito species in large areas of the United States and Mexico, he reminded his audience, may trigger an explosive epidemic of yellow fever. Although the last fatality from this disease in either country was recorded in 1924, Kerr pointed out that, thanks to rapid modern transportation, a person with the disease still in incubation may arrive in Houston, New Orleans, Progreso, or Merida any time. If *aegypti* mosquitoes find the patient before the health department does, infection, panic, and disorganization of the community may be expected, all for the lack of species eradication.

PHS Staff Appointments

Jack Masur, M.D., became director of the Public Health Service Clinical Center, National Institutes of Health, Bethesda, Md., on November 1, 1956. At the time of his appointment he was chief of the Bureau of Medical Services.

From 1948 to 1951 Dr. Masur supervised the planning and building of the center—the largest facility of its kind in the world—which officially opened in July 1953. Before joining the Public Health Service in 1943, he was assistant director of Montefiore Hospital, New York City, and executive director of Lebanon Hospital, also in New York City.

John W. Cronin, M.D., is the new chief of the Bureau of Medical Services. The bureau administers Public Health Service hospitals, programs for Indian health and foreign quarantine, surveys of dental and nursing resources, and grants for construction of hospitals and rehabilitation facilities under the Hill-Burton Act and amendments. As chief of the Hospital and Medical Survey and Construction Program from 1949 until his appointment, Dr. Cronin had the responsibility for administration of the grants program.

Vane M. Hoge, M.D., first director of the Hospital and Medical Survey and Construction Program, will assume administration of the Hill-Burton program in addition to his duties as associate chief of the Bureau of Medical Services.

Donald W. Patrick, M.D., director of the Clinical Center until Dr. Masur's appointment, has been appointed medical officer in charge of the Public Health Service hospital at San Francisco.

Under "on site" conditions, direct inoculation into cold untempered media of contaminated samples of sea water, followed by incubation 5 to 6 hours later, is a satisfactory technique for routine bacterial analyses.

Evaluating Bacterial Contamination in Sea Water Samples

By GERALD T. ORLOB, M.S. in C.E.

IT IS APPARENT that interpretation of the significance of bacterial analyses obtained during surveys of sewage pollution of sea water must be tempered with the realization that many factors influence their reliability. Not the least of these factors is the effect of bacterial die-away or regrowth during the period between sample collection and laboratory analysis.

Standard procedures for the bacteriological analysis of water samples usually recommend that inoculation be carried out as soon after collection as practical and that if storage is necessary the temperature should be kept between the limits of 0° C. and 10° C. Unfortunately, because many sites under survey are remote from adequate laboratory facilities, storage during transportation becomes essential. Needless to say, refrigeration, though desirable, is not always convenient or practical. In the routine practice of public health and pollution control agencies charged with the bacteriological analysis of contaminated waters, delays of 5 to 6 hours are not uncommon. Often storage of samples overnight may be necessary (even though not the preferred procedure) in some overworked laboratories.

Delays or failure to provide refrigeration may significantly influence the results of individual analyses and, consequently, invalidate certain conclusions which might be drawn from the aggregate of results from a certain water under survey. If the water being investigated is that of an ocean bathing beach, the results of analysis may be close to worthless.

Mr. Orlob, assistant professor of civil engineering at the University of California, performed the investigative work represented by this paper during the 3½ years he was in charge of water pollution and industrial waste surveys for the State of Washington Pollution Control Commission. Author of 14 reports and papers covering these investigations and of additional research reports associated with water reclamation, he is engaged at present in a fundamental study of the factors influencing the movement of bacteria in underground water. The project is sponsored by the Public Health Service.

Extent of Coliform Die-Away

The population of the coliform group of bacteria, the common presumptive indicator of domestic sewage contamination, is frequently subject to drastic change during the early hours of its exposure to a new and foreign environment. A review of available literature on the subject of survival of enteric bacteria in sea

water (*1*, *2*), reveals a few sources of information as to the extent of early die-away or growth in sea water samples.

For example, the experiments of Beard and Meadowcroft (*3*) indicate *Escherichia coli* mortalities in the waters of San Francisco Bay of about 68 percent in 0.8 days and 90 percent in 3.5 days.

Ketchum and his associates (*4*), and later Vaccaro and his co-workers (*5*), showed reductions of *E. coli* inoculations as great as 90 percent in raw Vineyard Sound water stored for 24 hours in laboratory containers at room temperature.

Williams (*6*) likewise noted considerable reduction in *E. coli* inoculums in natural sea water stored in the laboratory. He reported an average mortality of 90 percent in 25 hours. In samples of sewage suspended in dialysing tubing in the natural environment the coliform group of organisms suffered a 90 percent mortality in 25 hours although in a few cases growth was experienced.

Nusbaum and Garver (*7*) observed high mortalities of coliforms in laboratory tests, as great as 65 percent in 24 hours, but generally they noted growth rather than die-away in dialysing tubing suspended in San Diego Bay. Coliform survival curves representative of the observations of several of these investigators are shown in the figure.

Several experiments of mine on samples taken from Elliott Bay, Wash., near a large outfall discharging untreated sewage, showed mortalities up to 74 percent in 8 hours of storage. In experiments with a water sample taken from Budd Inlet, a salt water branch of Puget Sound which forms the harbor for Olympia, Wash., coliform die-away was 56 percent in 10 hours at a storage temperature of 20° C. A similar sample held for the same period at 3° C. showed a 38 percent reduction in coliform population. Samples prepared from dilutions of settled sewage and Pacific Ocean water collected off San Francisco showed mortalities as great as 92 percent in 24 hours at 30° C. and 68 percent at 21° C., with no significant change at 5° C.

The presence of organic nutrients may tend to offset bacterial die-away, but without refrigeration growth may occur in the early hours of storage. For example, the addition of lactose broth to a series of samples stored at 20° C. resulted in large increases in population during the first 24 to 48 hours of storage. A period of rapid die-away followed, but die-away occurred only after a substantial lag period. The magnitude of the initial rise, the length of the lag period, and the time for 90 percent mortality were all directly proportional to the concentration of nutrient added. The survival curve for one of these tests (120 p.p.m. lactose broth) also is shown in the figure along with the results of other experiments.

Die-Away Formulation

The figure illustrates certain similarities among the coliform survival curves obtained by different investigators. For example, each curve shows a characteristic logarithmic decrease phase with a slightly varying slope. Several curves, especially those in which growth occurred in the early stages of exposure, show a lag period before the onset of logarithmic decrease. And those experiments for which the data are sufficiently extensive indicate a resistant phase exemplified by a decreasing rate of decrease and the survival of a few coliforms for comparatively long periods of time. The decrease in bacterial numbers after an initial lag is perhaps best expressed by Chick's law (*8*, *9*), which may be written in the following form:

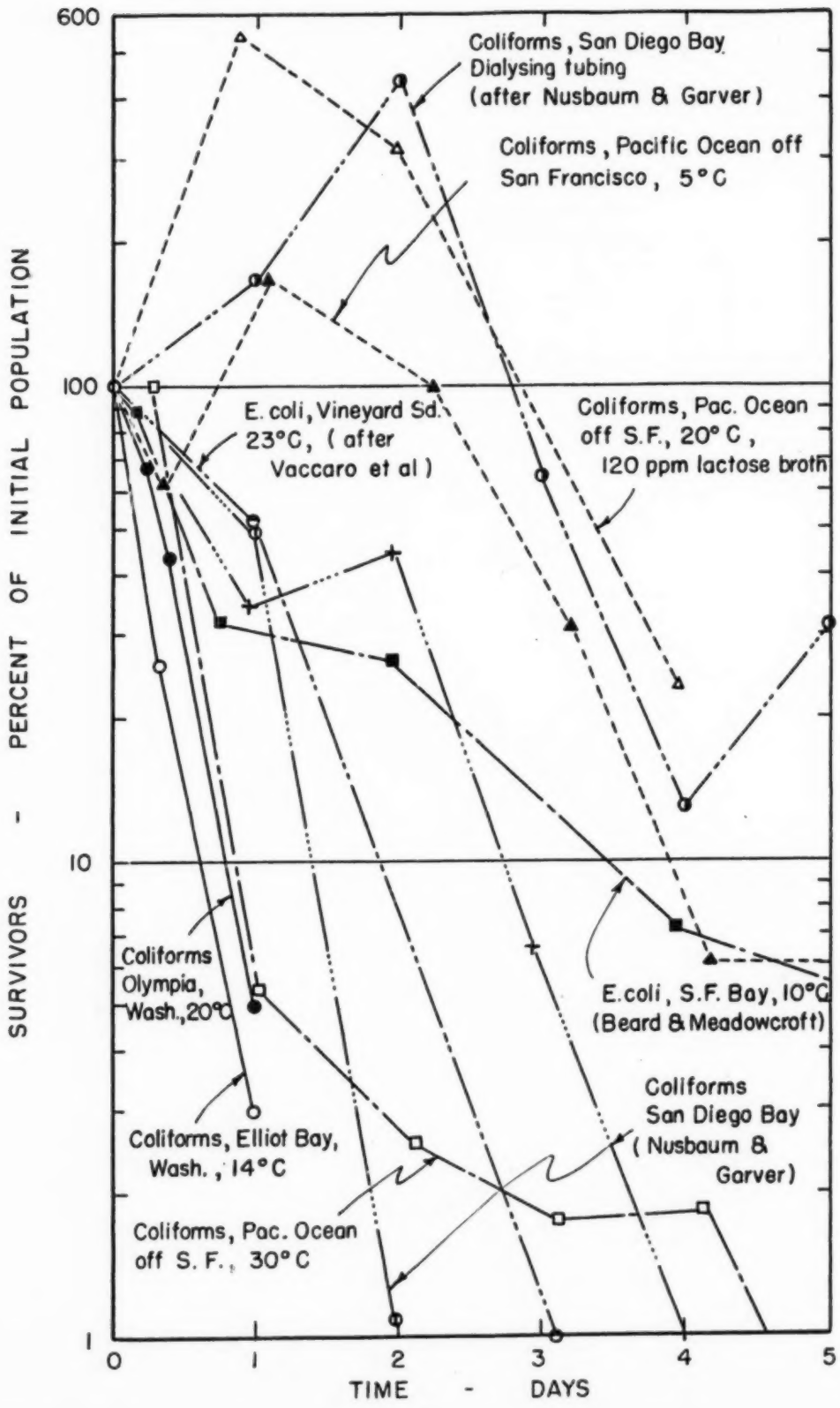
$$\frac{N}{N_o}=10^{-k(t-t_o)}.$$

N is the number of survivors after time t, in days; N_o is the initial bacterial population; t_o is the lag period before logarithmic decrease, and k is a constant.

Field Inoculation Technique

The State of Washington Pollution Control Commission, with due concern for the validity of bacteriological survey results on ocean and brackish waters, has adopted the practice of field inoculation at the site of sample collection in an effort to minimize bacterial die-away or multiplication during transport to the laboratory. This procedure, of necessity, requires that the inoculation be made directly into cold un-

Coliform Survival in Sea Water Samples



tempered media and that the inoculated tubes suffer the delay between sample collection and incubation normally experienced by the raw sample. This practice, while not representing the ideal condition for the preservation of the original bacteria in a viable state, does provide a better chance for an analysis truly representative of "on site" conditions.

The constant k, sometimes referred to as the coefficient of death rate, is indicative of the rate of bacterial die-away. It may be expressed as the reciprocal of the time in days required to achieve a 90 percent mortality of the initial number of bacteria when due account is taken of the initial lag period. It is generally greatest at high temperatures and during the summer months. Typical values of k range from about 0.3 (Beard and Meadowcroft, see figure) to 1.6 (my experiments at Elliot Bay, see figure). The majority of values fall between the limits 0.6 and 1.2.

The significance of the coefficient of death rate in terms of bacterial die-away during sample storage is best illustrated by a simple example. If it is assumed that k has an average value of 1.0 and that there is no appreciable lag, the number of coliforms remaining after 6 and 24 hours' exposure would be, according to the equation, respectively 56.3 percent and 10 percent of the original population.

If a lag period occurs, the sample usually experiences some growth rather than a decrease in population. In either case the bacteriological analysis, unless performed immediately at the site of sample collection, will yield unsatisfactory results. The obvious advantages of refrigeration, where it can be conveniently employed to suppress both bacterial growth and bactericidal activity, cannot be depreciated. It must be acknowledged, however, that under conditions of routine sample collection adequate refrigeration is not readily available. Moreover, when the bactericidal effect of sea water is strong, refrigeration may be somewhat less than satisfactory.

To determine whether or not a preliminary period of 5 to 6 hours in cold media would have any appreciable effect on the viability of bacteria, we compared the cold media inoculation procedure statistically with the tempered media inoculation procedure representative of the best possible practice.

First, from a single sample of settled sewage diluted 1:2,500 in tap water, we prepared twenty 1:10 dilutions in sterile water. Then, we divided the 20 samples into 2 groups of 10 each in order of initial inoculation, placing the odd numbers in group A and the even numbers in group B.

Working alternately from one group to the other, we inoculated all 20 samples according to the standard inoculation procedure and completed the test by confirmation on brilliant green bile broth. All inoculations consisted of five 1-milliliter portions in each of at least 3-decimal dilutions.

Table 1. Comparison of tempered media and cold media inoculation techniques

Sample[1]	Most probable number coliform organisms per 100 ml.	
	Group A[2]	Group B[3]
1	3, 300	1, 700
2	7, 900	2, 300
3	3, 300	3, 300
4	2, 300	4, 900
5	7, 900	4, 900
6	3, 300	4, 600
7	2, 300	2, 300
8	2, 200	2, 300
9	1, 700	3, 300
10	2, 200	4, 900
Arithmetic mean	3, 640	3, 450
Standard deviation	1, 910	1, 170

[1] 1:2,500 dilution of settled sewage in tap water.
[2] Inoculated immediately into tempered media (37° C.) and incubated.
[3] Inoculated immediately into cold media (23° C.). Stored 6 hours at 23° C., then incubated.

We analyzed group A samples in standard strength lactose broth tempered to 37° C. before inoculation, and immediately after inoculation placed the samples in the incubator.

We examined group B samples in the same media but at a temperature of 23° C., and then stored the samples for 6 hours at the same temperature before incubating them at 37° C.

The results of this experiment (table 1) revealed no significant difference between the two procedures. In fact, the spread in individual

observations indicated by the standard deviation from the mean was actually less, though not statistically significant, in group B (cold untempered media) than in group A (tempered media).

To illustrate the effect of short-term changes in bacteria populations in sea water samples and to test the applicability of several storage and handling techniques, we conducted a special series of experiments during an actual bacteriological survey of Budd Inlet, Wash.

We made 14 examinations of the coliform content of the water near a single survey station off the port of Olympia, Wash., from September 1951 through May 1952.

The samples were collected under the wide variety of conditions that would be encountered on any routine field survey. The harbor at Budd Inlet received the untreated sewage discharge from the city of Olympia throughout the 9-month survey period. In addition, the inlet provided the egress for runoff of an extensive area drained by the Deschutes River. A combination of runoff, waste discharge, tidal fluctuation, and climatic variations provided considerable variety in salinity, temperature, amount of dissolved oxygen, and organic content. A summary of individual survey observations is presented in table 2.

We examined each of the samples collected at the survey station by four distinctly different procedures. Immediately after collection of the sample, an inoculation was made into tempered (37° C.) lactose broth as well as into cold media. The temperature of the cold media was close to that of the surrounding air (13° C. to 23° C.). The tempered media series (series A) was incubated without further delay at 37° C. and served as a control for evaluation of other techniques. The samples in the cold media series (series B) were held at air temperature for periods ranging between 5 and 6 hours, a time corresponding to the maximum delay between collection of field samples and inoculation procedures in the laboratory. The samples were then incubated at 37° C.

We divided the original sample into two portions. One (series C) we stored at normal air temperature for 5 to 6 hours, and the other (series D) we refrigerated at 6° C. for a similar

Table 2. Survey observations for State of Washington Pollution Control Commission sampling station, Budd Inlet, Olympia, Wash., 1951–52

Sample	Date	Range of water storage temperature (degrees centigrade)		Storage time (hours)	Dissolved oxygen (p.p.m.)	Biochemical oxygen demand [1] (p.p.m.)	Salinity (p.p.m. NaCl)	Most probable number of coliform organisms per 100 ml.			
		Low	High					A [2]	B [3]	C [4]	D [5]
1	9–14–51	19. 8	21. 4	4. 8	9. 7	3. 0	24, 300	3, 500	2, 400	490	2, 200
2	9–26–51	15. 0	23. 0	5. 6	9. 8	5. 5	28, 500	300	490	490	1, 700
3	10– 4–51	14. 7	19. 8	4. 8	7. 1	2. 2	25, 000	1, 300	2, 400	790	490
4	10–10–51	14. 5	19. 2	5. 0	6. 7	2. 9	26, 000	5, 400	2, 400	1, 700	2, 200
5	10–19–51	13. 0	19. 0	5. 0	6. 4	1. 1	24, 500	3, 500	3, 500	1, 300	490
6	10–30–51	10. 9	20. 3	5. 0	6. 1	1. 4	21, 800	1, 300	1, 400	1, 300	2, 400
7	12–12–51	7. 7	13. 0	6. 0	9. 2	1. 9	11, 100	950	790	330	330
8	1– 9–52	6. 9	21. 4	5. 0	8. 9	2. 6	26, 100	490	490	330	330
9	1–21–52	6. 6	14. 0	5. 8	8. 7	. 7	25, 400	330	490	130	230
10	2– 4–52	7. 4	23. 3	5. 2	9. 1	2. 7	21, 900	3, 500	3, 500	1, 100	460
11	2–27–52	7. 1	17. 7	5. 2	9. 2	1. 1	12, 500	1, 100	790	1, 300	1, 700
12	3–18–52	7. 9	16. 3	5. 0	9. 5	1. 5	24, 900	230	230	330	220
13	4–29–52	11. 0	17. 0	5. 1	10. 7	3. 0	28, 200	330	330	330	330
14	5–29–52	14. 0	17. 0	5. 3	10. 0	3. 1	26, 400	490	490	490	460

[1] Dissolved oxygen consumed during 5 days' incubation of water sample in the dark at 20° C.
[2] Series A (control series). Inoculation into tempered media (37° C.) immediately after collection.
[3] Series B. Inoculation into cold media (storage temperature) immediately after collection; stored 5–6 hours before incubation at 37° C.
[4] Series C. Stored 5–6 hours at indicated temperatures before inoculation into tempered media, then incubated at 37° C.
[5] Series D. Refrigerated 5–6 hours at 6° C. before inoculation into tempered media, then incubated at 37°C.

Table 3. Effect of method of storage and technique of analysis on 14 samples in each series from the bacteriological survey of the State of Washington Pollution Control Commission at Budd Inlet, Olympia, Wash., 1951–52

Procedure [1] for storage and analysis of sample	Most probable number of coliform organisms per 100 ml.				Percent of samples with MPN greater than 1,000	Probability that difference from control is due to chance alone [2] (percent)
	Range	Median	Arithmetic mean	Geometric mean		
Series A (control) [3]	230–5, 400	1, 025	1, 625	990	50	
Series B [3]	230–3, 500	790	1, 407	970	43	[4] 40
Series C [3]	130–1, 700	490	744	592	36	[5] 3
Series D [3]	220–2, 400	475	960	647	36	[6] 17

[1] One analysis in each series from the same original specimen.
[2] Null hypothesis. See reference 10.
[3] Same series identified in text and in table 2.
[4] No significant difference.
[5] Significantly different.
[6] Significant difference questionable.

period. We inoculated each sample after storage into tempered media, and then incubated it in the customary fashion. We used 5 portions of 3-decimal dilutions from each sample to determine the most probable number (MPN) of coliform organisms per 100 ml. of the original sample. A summary of the results of these tests is given in table 3.

These experiments indicate that bacterial die-away during storage, even for comparatively short periods, may seriously affect the interpretation of survey results. It is particularly significant that, even though one series (series D) of samples was refrigerated, an appreciable reduction in bacterial numbers occurred in this series. As we expected, the greatest population change occurred in the portion of the original sample that was stored at normal air temperature before inoculation. This observation is in accord with the results of die-away studies performed on Pacific Ocean water collected near San Francisco in which death rates were observed to be directly proportional to temperature, and refrigeration was noted to induce an appreciable lag prior to die-away (*2*).

Application of the "null hypothesis" (*10*) for testing the significance of the differences in mean values given in table 3 indicates a comparatively small probability that the differences between the mean of the control series A and the mean of either series C or series D could have resulted from chance alone. However, when this statistical test is used to compare series B, the cold media inoculations, with the control series (series A), the difference is not statistically significant. It is readily apparent that when the bactericidal effect of sea water is high a comparatively short delay in inoculation into media, even cold media, may produce a much different picture of contamination than that actually existing at the time of sampling. Even refrigeration of the samples may not be sufficient to arrest bactericidal action although this practice is undoubtedly much superior to storage of the sample at normal air temperatures.

Summary and Conclusions

Changes in populations of coliform bacteria in contaminated sea water during the early hours immediately following collection of the sample may have a significant bearing on the interpretation of the results of bacteriological surveys. Refrigeration of samples, although generally recommended when extended storage of samples is necessary, is not always capable of minimizing the bactericidal effect of sea water. Direct inoculation of the sample into cold media at the sampling site, with a 5- to 6-hour delay in incubation, produces results which are generally comparable with direct inoculation into tempered media followed by immediate incubation. This method is used by the State of Washington Pollution Control Commission and is recommended for general use on bacteriological surveys of sea water.

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technical publications

A Digest of State Enabling Legislation for Mosquito Abatement Through 1955

PHS Publication (unnumbered). 1956. 83 pages.

This publication covers the laws on mosquito abatement in existence in 24 States. It is intended to provide the basis by which State and local groups responsible for such activities can evaluate or compare their existing legislation or acquire the context and terminology for drafting new legislation; to provide the procedures for initiating, directing, and operating a program; and to provide Federal and State officials with basic information for planning and coordinating these activities.

The codification for each law includes the following: legislative history, authorization and procedures for formation, boards of control and their powers and duties, guidance and coordination, financing, annexation, consolidation, and penalties. Also included in the publication is a summary table on financing.

Copies of this booklet can be obtained from the Communicable Disease Center, Public Health Service, Atlanta 23, Ga.

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PHS Publication No. 23. Revised 1956. 19 pages; illustrated. 20 cents.

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PUBLIC HEALTH SERVICE
LEROY E. BURNEY, *Surgeon General*

THIS INDEX to *Public Health Reports* is divided into two parts: a subject and an author index.

In addition to the subject headings, categorical headings include: ANNOUNCEMENTS, CONFERENCE REPORTS, DEATHS, FILMS, FRONTISPIECES, GRANTS AND FELLOWSHIPS, LEGAL NOTES, PUBLIC HEALTH MONOGRAPHS, PUBLICATIONS, REVIEWS, TRAINING COURSES AND PROGRAMS.

Titles of articles appear as entries under the appropriate subject heading, followed by the author's name in brackets. One asterisk before the page number indicates an original article; two asterisks indicate a Public Health Monograph, published concurrently with *Public Health Reports*.

Illustrative material on the inside of the front cover of each issue is indexed by month under the heading "FRONTISPIECES." It is recommended, therefore, that the covers be included in a bound volume.

A compiled annual list of Public Health Service publications may be obtained from the Public Inquiries Branch.

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CORRECTIONS

FEBRUARY ISSUE, p. 162, 2d column. beginning with line 8 of the article entitled "Public Health in Pennsylvania," by Berwyn F. Mattison, change to: "average infant death rate of 14.6 per 1,000 live births, but our poorest 3 cities have an average death rate of 31.0. This means that for every 31.0 baby deaths in one kind of community the other community has only 15.0."

JULY ISSUE, p. 654, table 2 of the article entitled "Effect of Fluoridated Public Water Supplies on Dental Caries Prevalence," by F. A. Arnold, Jr., H. T. Dean, P. Jay, and J. W. Knutson, the def rate for 7-year-olds in 1950 should read "4.72", and the def rate for 11-year-olds in 1953 should read "1.09", both in Grand Rapids, Mich.; p. 655, table 3, in the same article, the DMF rate for 6-year-olds in Grand Rapids, Mich., in 1953 should read "0.19."

SEPTEMBER ISSUE, p. 907, 2d column, line 28 of the Tuberculosis Conference brief entitled "Pulmonary Nodules Found in Cleveland Survey," by Holin and others, insert the word "malignant" before the word "nodules" to read: "Most of these malignant nodules were diagnosed early" and in line 39, insert the word "calcified" after the word "appeared" to read: "None of these nodules appeared calcified on the original film."

OCTOBER ISSUE, p. 957, 1st column, line 5, in the article entitled "Nerve Gas in Public Water," by Joseph Epstein, equation [2] should read: "$\theta_{1/2} = (5.4 \times 10^8)\ (10^{-pH})$"; and p. 1064, 2d column of article entitled "Shellfish Sanitation Workshop," beginning with the 1st line below the table, read: "The workshop adopted a resolution requesting the."

DECEMBER ISSUE, p. 1213, 1st column, in the authors' identification of the article entitled "Rural Health Survey of Men Over Forty," by John Pemberton and Kenneth I. E. Macleod, credit should have been given to the North Worcester County Public Health [Tuberculosis] Association for financial help.

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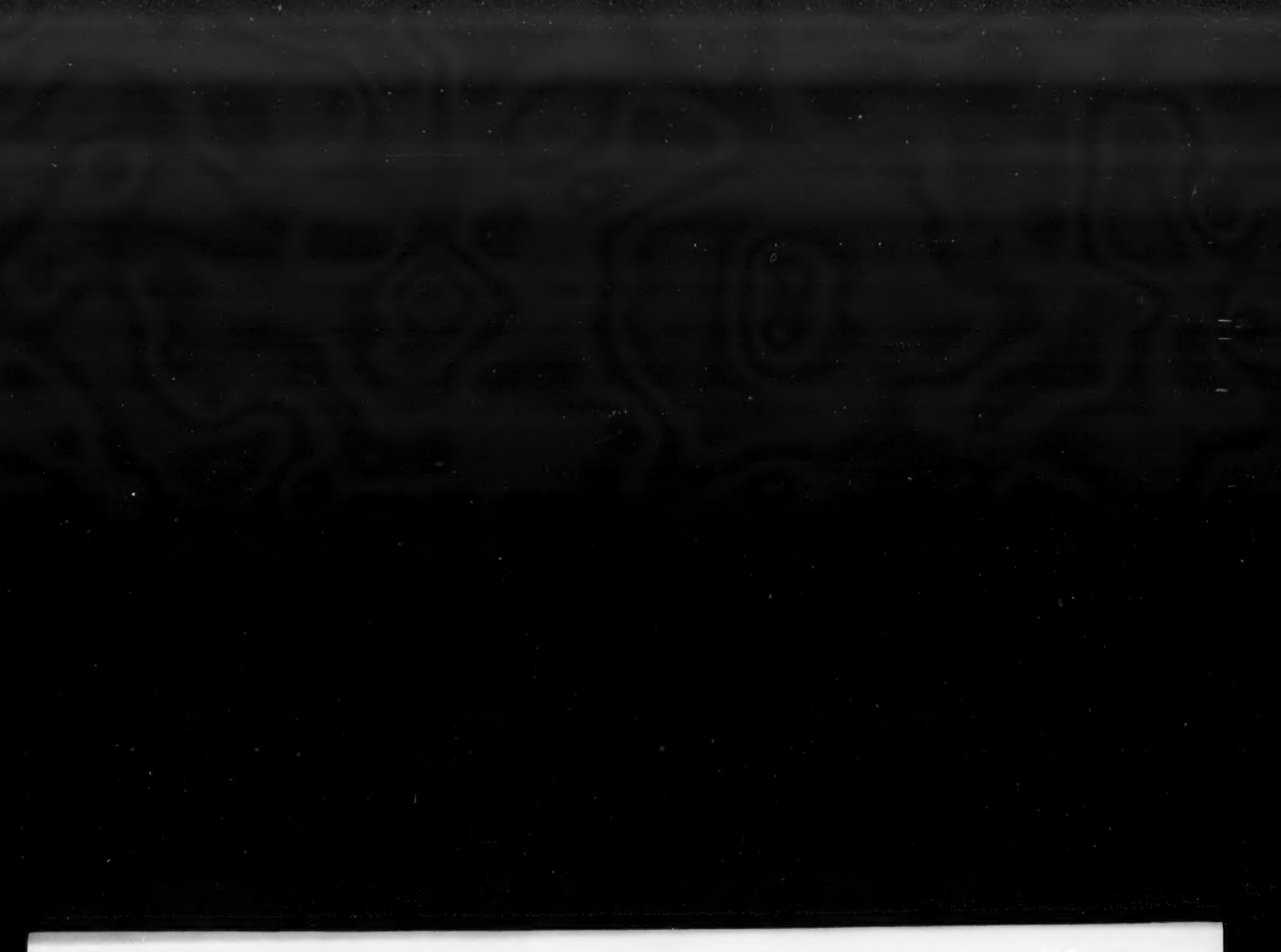
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